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RECENT DEVELOPMENTS IN INTESTINAL BACTERIOLOGY.

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The privilege of addressing the Pathological Society of Philadelphia is one I esteem very highly. The subject suggested for this evening's discourse, "Intestinal Bacteriology," brings into apposition two wide fields of bacteriology which have interested my colleagues and myself for many years, namely, the chemical activities of bacteria, on the one hand, and the nature of the relations existing between alterations in the diet and the character of bacterial response in the alimentary canal, on the other hand.

Introduction. The belief that the intestinal flora is fundamentally a physiological unit rather than a heterogeneous collection of adventitious microbes has afforded opportunity for a new avenue of approach to this complex subject. Viewed from this angle, the kaleidoscopic aggregation of microörganisms which comprise the normal intestinal flora stands in a rather definite relation to the diet of the host. That is to say, as the diet is changed along definite lines a dual bacterial response may be elicited. The types of bacteria may, and frequently do, shift. Those organisms which cannot accommodate themselves to the new nutritive environment tend to diminish in numbers, and other, more adaptable, types take their place. A less spectacular but frequently more significant response is that in which the products of the metabolic activity of the intestinal microbe change is parallel with the nutritional stimulus. The

metabolic products of normal intestinal bacteria are essentially innocuous, but it is by no means an exaggeration to state that a given bacterium may be potentially either a veritable Dr. Jekyll or Mr. Hyde through the products it forms from one or another normal constituents of the diet of the host. Fortunately the latter organisms are relatively uncommon and abnormal. Many pathogenic bacteria are of this type, however, and their dual chemical personality will be commented upon in an appropriate place.

Information relating to bacterial development in the intestinal tract is derived from two principal sources—the bacteriological examination of intestinal contents at varying levels under varying conditions and artificial cultivation of the same, or similar microbes, singly or in mixtures, attempting to reproduce meanwhile the intestinal environment. Up to the present time it has not been possible to produce an artificial intestinal canal with its complex associated conditions. This of course limits very decidedly the range of experimental possibilities, but the timely utilization of fistulæ in man, intensive studies of animals and other possibilities that suggest themselves are fruitful sources of information. The results which have flowed from experiments and studies on record at the present time, immature though they may be, are full of promise that a new and wide field of therapeutics may be unfolded in the future. For the present a brief summary of existing information and an equally brief indication of the relation of existing theories to future developments must suffice.

Analyses of Intestinal Contents. It has been estimated that a normal adult on an average, well-balanced ration excretes daily in the feces nearly thirty trillion of bacteria. The nitrogen contained in the dried bodies of these organisms equals about 50 per cent. of the total nitrogen of the feces, and these dried bacteria alone would weigh nearly 8 gm. More than 0.5 gm. of nitrogen therefore is contained in that moiety of the feces which is composed of bacteria. It is apparent that the food ingested does not contain this very large number of microbes, hence the assumption must be that the alimentary canal is the site of a tremendous daily bacterial proliferation. The alimentary canal is probably the most efficient combined culture medium and incubator known to bacteriology. Striking as these analytical figures may be there is an even more noteworthy phenomenon discernible—that peculiar, well-defined alternation of bacterial types which normally follows very closely the nutritional history of the individual from early infancy to adult life.

Intestinal Bacteriology. At birth the intestinal tract and intestinal contents are normally sterile. The first indications of bacterial contamination are recognizable several hours postpartum. The early invaders are adventitious microbes, similar in every respect to those commonly present in the infant's environment. They gain

entrance to the alimentary canal through the mouth, although the possibility of rectal infection must be borne in mind. As a rule the proliferation of these organisms is limited, partly because the intestinal contents at this time are inadequate to support a large bacterial population, partly because a majority of the bacteria are unable to accommodate themselves to gastro-intestinal conditions.

About the third day postpartum the alimentary canal of the infant becomes permeated with breast milk in place of the colostrum, and this condition prevails in nurslings for several months. A marked change is discernible in the intestinal flora at this time. The heterogeneous, irregularly staining initial microbes disappear to a remarkable degree, and, coincidently, large numbers of long, slender, Gram-staining bacilli appear. Many of these exhibit slightly attentuated ends. A majority of these belong to the group of Bacillus bifidus, and they usually persist in dominant numbers during the nursling period.

The reaction of the feces now becomes definitely acid, indicating a unification in the character of the products arising from the development of the characteristic nursling flora. The conditions just described as characteristic for normal nurslings persist relatively unchanged until the dietary requirements of the child exceed the possibilities of nutrition at the breast alone. It is worthy of note that artificially nourished infants frequently fail to exhibit this rapid homogenation of the intestinal flora; indeed, the flora of infants nourished upon cows' milk or other unnatural food is relatively heterogeneous in respect to bacterial types, as a rule.

As the diet becomes more varied a marked change is noticeable in the general appearance of the intestinal organisms. That monotony of type which is associated with the monotony of diet (breast milk) gives way to considerable variations in size, form and tinctorial reaction of the microbes comprising the intestinal flora. These changes are, generally speaking, a substitution of Gram-negatively staining bacteria of the colon type for a considerable proportion of the Gram-positively staining organisms so distinctive of the flora of the normal nursling, as well as the appearance of large bacilli (many of them spore-forming) cocci and variable numbers of microbes that vary from time to time and from individual to individual.

The consistency and chemical composition of the feces likewise undergo changes which follow the dietary history of the child rather closely. The homogeneous, pasty, acid stool characteristic of nurslings gradually becomes less acid in reaction, somewhat disagreeable in odor (due to the presence of aromatic bodies, such as indol and skatol) and more formed. This change in intestinal bacteria, intestinal contents and in the general character of the composition of the intestinal residuum, which appears to have its origin in the amplification of diet of the young child, progresses

slowly until a new period of stability is reached. This is the time of late adolescence and maturity. The intestinal enzymes are now mature, the dietary habits are well-established and in health the intestinal flora appears to reach an equilibrium. At this time the coliform organisms, few in number in the nursling, comprise more than 50 per cent. of all viable intestinal microbes. It may be stated that coliform bacteria are as characteristic of the intestinal flora of adults as the long, thin Gram-staining bacilli (Bacillus bifidus) are characteristic of the intestinal flora of nurslings.

That portion of the above presentation which relates solely to the dominence of Bacillus bifidus in the intestinal flora of the normal nursling and its gradual replacement of coliform and other bacteria in older children has been recorded independently by many investigators. It may be confidently stated that it represents accurately the sum total of generally accepted knowledge of this subject at the present time.

The all-important problem for solution is, "Why should there be this striking and fairly definite sequence in the types of bacteria in the intestinal tract, coinciding in point of time with alterations in the diet of the host?" A discussion of this problem together with certain considerations which flow naturally from it form the basis of this lecture. A considerable proportion of the investigations upon which the discussion hinges represents published and unpublished studies of the writer and his colleagues. Naturally, time does not permit of specific mention of them.

A large variety of bacteria certainly gain access to the alimentary canal; of these, surprisingly few types seem to establish themselves. A professional fasting man who has partaken of no food for thirty days, harbored large numbers of colon bacilli in the large intestine, showing very plainly that the accumulated detritus is sufficient to sustain a numerous bacterial population. Normally, many types of organisms are introduced with the food, but of these relatively few appear to find intestinal conditions favorable for their continued growth. Those that do persist are not, as a rule, dominant in the food. Nevertheless, food plays an important part both in determining the types of bacteria which become implanted in the alimentary canal and in regulating the character of the products of metabolism of these organisms incidental to their growth.

The normal diet of the nursling is breast milk which contains nearly 7 per cent. of lactose and but 1.5 per cent. protein. The relatively frequent feedings assures the presence of at least minimal amounts of it in the large intestine at all times. The intestinal flora which is associated with this monotonous diet is conspicuously homogeneous in type and in chemical activity. The dominant organism Bacillus bifidus greatly outnumbers all other bacteria and the lactic acid it produces from the fermentation of the lactose gives a physiological acidity to normal nursling feces. There is therefore

a noteworthy parallelism between the monotonous diet of the nursling, the monotony of the bacterial flora in the nursling rectal contents and a continued acid reaction in the nursling dejecta. Artificially nourished infants do not, as a rule, exhibit this phenomenon in its entirety.

These essential details are reproducible in certain laboratory animals. Consequently the general premise that a definite relationship exists between the diet of the normal nursling and the character of the intestinal bacterial flora may be regarded as tentatively sound.

As the child becomes older and the diet becomes more complex the intestinal flora undergoes a distinct change. The significant dietary factor is a material reduction in the proportion of carbohydrate to protein; the striking bacterial response is a sharp decline in the proportion of obligately fermentative bacteria, prominent among which is Bacillus bifidus, and a remarkable increase in the coliform organisms, which thrive equally in a medium relatively rich in carbohydrate or in one in which carbohydrate is practically absent. It should be remembered that the dominance of coliform organisms in the alimentary tract does not result from a dominance of coliform organisms in the food. Indeed, the members of this group of bacteria are not particularly numerous in proportion to the other types of bacteria in the carefully prepared pabulum of childhood. In other words, the types of bacteria found in the alimentary canal do not reflect in type or proportion those commonly found in the food.

In addition to the ascendency of coliform organisms at this period in the digestive history of the child there is discernible a rather well-marked regional distribution of bacterial types from the higher to the lower levels of the intestine. Also, those organisms in actual contact with the intestinal wall do not necessarily coincide in type or numerical distribution with those found at the same level which are in the actual intestinal contents.

An explanation of the phenomena so briefly outlined above clearly involves the dual conception of bacterial adaptation to environmental conditions and the character of their metabolism as well.

Bacteria, from the view-point of alimentology, may be considered as digestive systems working within a digestive system, each individual bacterium being a complete system in itself, the entire viable bacterial population growing within the alimentary canal of the host. There is an important difference between the two systems in that the entire digestive history of the microbe is carried out within the limits of the alimentary canal, whereas only the preparation and assimilation of food for the host occurs within this restricted field. It follows that the products resulting from the intracellular utilization of food by bacteria are excreted again into the intestinal tract, whereas the products resulting from the intracellular utili-

zation of assimilated food of the host do not necessarily reappear in the tract again. The products of metabolism of the parasite, in other words, may react upon the host, but under ordinary conditions those of the host are of minimal consequence to the parasite.

It is probable that the essential phenomena of metabolism of host and microbe alike possess some characteristics in common. The nutrition and general metabolism of bacteria, however, is a subject of recent investigation and not well known. It is pertinent, therefore, to mention briefly certain salient features of it in this connection.

Bacterial Metabolism. Generally speaking, there may be recognized two distinct phases in the life history of a bacterial cell: (1) a structural or anabolic phase, comprising the phenomena of growth and maintenance of the organism and its appendages, including the replacement of losses due to enzyme formation and other vital repairs, (2) and a catabolic vegetative or energy phase which comprises the phenomena attendant upon the energy requirements necessary to maintain the vegetative activities of the cell.

Bacteria are very small. Five hundred million typhoid bacilli would weigh rather less than a milligram. It is apparent, therefore, that even with a very liberal allowance for waste the actual amount of material required to build such a bacterial cell would be very little indeed. Nevertheless, many kinds of bacteria, in spite of their minute size, produce very noticeable and rapid chemical changes in their environment, as a result of their development. This marked disproportion between the size of bacteria and the magnitude of their chemical activity appears to be explainable upon that biological principle which maintains that the energy requirement of living things varies with the surface area rather than the volume of the organism. The volume (and consequently the weight) of a million typhoid bacilli, for example, is extremely small. The aggregate surface, however, is surprisingly large. A million typhoid bacilli weigh approximately 0.002 milligram. The surface area of these bacteria, however, is nearly 10 square millimeters. It is not wholly surprising, therefore, that microörganisms, even as small as bacteria, produce chemical changes in their environment quite out of proportion to their size.

The relation between surface area, volume and the magnitude of the organism's metabolism cannot be carried too far, however. A typhoid bacillus and a proteus bacillus, for example, are very nearly equal in all dimensions; yet a proteus bacillus will induce changes in its nutritive environment many fold greater than a typhoid bacillus. As a general rule, strictly pathogenic bacteria are noticeably less active chemically than parasite organisms, and the latter are frequently much less reactive chemically than saprophytic microbes.

Returning once more to the structural requirements of bacteria,

it is a fact that nitrogen in appropriate combination with carbon, hydrogen and oxygen is absolutely essential for the growth of bacteria. It is not surprising, therefore, that bacteria will not develop in pure saccharine solutions.

The energy requirements, on the other hand, are essentially transformations of suitable combinations of carbon with oxygen and hydrogen. Nitrogen plays an insignificant part, as a rule, in this phase of bacterial activity. When utilizable carbohydrates are present in the nutritive environment of most bacteria the products formed are chiefly those arising from the fermentation of such substances, and chemical evidences of the utilization of nitrogenous substances are minimal.

When utilizable carbohydrates (or similar available non-nitrogenous substances) are not available the bacteria must obtain not only the structural requirements, but the energy requirements as well, from the nitrogenous constituents of the medium. Under these conditions, nitrogenous waste products become relatively prominent. Without entering into details a few well-known examples of the relation between the utilization of nitrogenous and non-nitrogenous substances for energy may be introduced. The diphtheria bacillus, grown in appropriate nitrogenous media containing no utilizable sugar or an amount of sugar which the organism can use up without inhibiting its further activity, will produce a very potent soluble toxin. If the *same* organism is grown in the *same* nitrogenous medium, to which is added sufficient utilizable sugar so that the organism cannot use it up, it will be found that no toxin whatever will appear in the culture. Similarly, the colon bacillus grown in sugar-free nitrogenous media will produce indol, ammonia, hydrogen sulphide and other products indicative of the break-down of protein; but the *same* organism grown in the *same* nitrogenous medium, to which utilizable sugars are added, will not contain any of these products indicative of protein break-down. On the contrary the characteristic products are organic acids, carbon dioxide and hydrogen.

The proteus bacillus is one of a considerable number of bacteria which produce a soluble enzyme in sugar-free gelatin, which liquefies this protein. The sterile filtrate of such a liquefied gelatin culture will contain enough free enzyme to liquefy an additional amount of gelatin. The addition of a *small* amount of utilizable sugar to gelatin cultures of the proteus bacillus will prevent *temporarily* the formation of this enzyme in an active state and the addition of a *considerable* amount will *permanently* prevent the development of the gelatin-liquefying enzyme. It is worthy of note that the mature, soluble, gelatin-liquefying enzyme, freed from bacteria by filtration through a porcelain filter, will liquefy sterile gelatin containing the same sugar which *in culture* prevented the formation of the enzyme, clearly suggesting that the presence of utilizable carbohydrate

prevented the *elaboration* of the enzyme, but had no effect upon the *action* of the enzyme once it was excreted in an active state.

The relation between the factors which form the production of this proteolytic enzyme and those which are associated with its action when it is mature is even more striking. Chemical examination of cultures (free from utilizable carbohydrate) in which the enzyme develops in increasing proportions shows the presence of increasing amounts of ammonia. A similar examination of sterile gelatin mixtures (with or without carbohydrate), in which the germ-free enzyme induces liquefaction, fails to reveal any increase whatsoever in ammonia. Apparently the activity of the enzyme is independent of ammonia formation. Nevertheless, ammonia formation invariably occurs when the enzyme is formed by the bacillus. The facts presented would seem to justify the following deductions: The soluble, gelatin-liquefying enzyme of Bacillus proteus is formed when the organism utilizes protein for its energy. It is not formed in an active state when utilizable carbohydrates are *continually* available for energy. (Small amounts of carbohydrate insufficient to prevent the development of the organism have been shown in similar experiments to inhibit enzyme formation until the carbohydrate is used up. Acid within the limits of tolerance of the organism does not inhibit enzyme formation.) The function of the enzyme is to prepare protein for assimilation by the organism, as the enzymes of the alimentary canal of man prepare proteins for assimilation. Ammonia formation is a measure of the deaminization of the assimilated protein fragment and not a concomitant feature of the action of the enzyme *per se*. The ammonia is "bacterial urea." Other organisms which form similar soluble proteolytic enzymes react in like manner to the presence of utilizable carbohydrates.

The protective or sparing action which utilizable carbohydrate exhibits for protein or protein derivatives in cultures of bacteria has its counterpart in higher organisms. The underlying principle is apparently analogous to that in man: Physiologists have long stated that the oxidation of carbohydrates protects the protein of the body. Carbohydrates, in other words, are protein sparers, and, as Howell has aptly stated it, "as the carbohydrate food is increased the protein food may be diminished down to a certain irreducible minimum, which is probably the amount necessary for the reconstruction of new tissue." The sparing action of carbohydrate for protein of bacteria is chiefly of significance in relation to the energy phase of bacterial metabolism.

It might be claimed that the toxicity of the protoplasm of bacteria would be a factor to be considered in this connection. Space does not permit of a discussion of the diminution of nitrogen in the bodies of bacteria developed in saccharine solutions as contrasted to that of the same organisms grown in nitrogenous media of otherwise similar compositions.

The sparing action of utilizable carbohydrate for protein in cultures of bacteria has a deeper significance than has been realized hitherto. The diphtheria, colon and proteus bacilli, to mention merely those referred to above, form widely different products as the result of their growth in nitrogenous media from which utilizable carbohydrates are excluded. The same is equally true for typhoid, paratyphoid, dysentery, hemorrhagic septicemic, tetanus, "gas," symptomatic anthrax and many other pathogenic bacilli, cholera and other vibrios and a large number of saprophytic organisms as well. Stated differently, it is positively known that diphtheria and tetanus bacilli form highly specific soluble toxins as they develop in protein media. They form innocuous fermentation products, chiefly acids, as lactic and acetic, from the same media to which utilizable carbohydrates are added. That which makes diphtheria and tetanus bacilli formidable, in other words, is apparently inseparably associated with their growth in nitrogenous but carbohydrate-free media. The antithesis of this specificity of products developed in nitrogenous, sugar-free media is manifested in the remarkable similarity of products formed in the same media which contains utilizable carbohydrate in addition. The nitrogenous products formed by typhoid, dysentery, cholera and other pathogenic organisms are unknown as yet, but the simple addition of utilizable carbohydrate to cultural media in which they are grown causes them to produce fermentation products, as lactic acid, precisely as the diphtheria bacillus does under similar circumstances. The chemical products formed by these bacteria in the presence of utilizable carbohydrate are potentially those produced by the Bulgarian bacillus; that is to say, a large number of bacteria pathogenic for man become potentially lactic acid bacilli when they are grown in fermentation media, and from this point of view, therefore, their specificity of action is inseparably associated with the utilization of protein for energy.

Typhoid, dysentery and diphtheria bacilli do not ferment lactose. If milk contained dextrose in place of lactose, or if at least 0.5 per cent. of dextrose were added to it, these organisms would produce sour milk as the result of their growth in it and this sour milk would not differ qualitatively from that produced by the Bulgarian bacillus. Furthermore, so long as the bacteria were confronted with this dextrose they would continue to make sour milk until the acidity reached a degree incompatible with their further growth. If the utilizable carbohydrate were removed, of course they would act once more upon the protein.

Correlation between the Diet of the Host and the Types of Bacterial Flora in the Intestinal Tract. Turning now to the alternation which takes place in the bacterial flora of the intestinal tract from earliest infancy to adult life, it has already been stated that the change in the intestinal bacteria follows very closely

the change in the diet of the individual. During the nursling stage, when the diet is almost wholly breast milk, the bacteria discernible in the intestinal contents and, when proper methods are used, cultivatible from the intestinal contents, are very largely of a single type known as Bacillus bifidus. Bacillus bifidus is an obligately anaërobic organism whose chemical activity is restricted quite closely to the fermentation of milk-sugar and other carbohydrates resulting in the formation of lactic acid.

In the absence of lactose this organism grows very poorly, and this is quite in accord with the well-known disappearance of Bacillus bifidus when the diet of the young child is relatively restricted in carbohydrates with a coincident increase of the protein. Lactose is present in breast milk to the extent of 7 per cent., while the protein is less than 2 per cent.; therefore the milk-sugar, under normal conditions, permeates the entire intestinal tract of the nursling. It is not surprising, consequently, to find that an organism which utilizes lactose readily without producing products inimical to the well-being of the host is one which is prominently represented in the nursling intestinal flora. It has been actually possible in a considerable number of experiments (particularly those carried out in young animals) to reproduce the characteristic nursling flora, with a very considerable amount of faithfulness by suitable feeding experiments. Similar experiments carried out in older animals are frequently unsuccessful, however, an explanation for this difference in response not being available at the present time.

When the diet of the child becomes more varied, which usually means a coincident diminution of the proportion of carbohydrates to protein, the normal, homogeneous intestinal flora gives way to a more heterogeneous picture, in which, however, there may be recognized at least a well-defined tendency for certain types of bacteria to thrive at particular levels in the intestinal tract. It is of course obvious that at any given level there will be found, in addition to those bacteria which find conditions favorable for their development, representatives from higher levels as well. The latter organisms are presumably transported mechanically with the intestinal contents to the lower levels. Consequently, the fecal flora contains representatives of all the microbes which develop freely in the intestinal contents. It should be remembered, however, that the large majority of the fecal bacteria are either weakened in vitality through the accumulation of waste products, the effect of desiccation and other factors, or they are dead.

It should be repeated that one of the most important factors which plays a part in bringing about this change in the intestinal flora is the carbohydrate content of the diet, particularly the relative reduction in the proportion of lactose. Carbohydrates, generally speaking, are readily hydrolyzed into hexoses, and as readily absorbed from the alimentary tract. Proteins, on the other hand,

undergo a comparatively elaborate simplification before assimilation. It follows, therefore, that the natural result of a reduction of carbohydrate in the diet and the relatively rapid assimilation of carbohydrate from the intestinal contents is the establishment of a zone in the intestinal tract where under normal conditions the amount of carbohydrate waxes and wanes. At this level it might be confidently predicted that Bacillus bifidus would not thrive, because, as has been stated previously, this organism is almost obligately dependent upon carbohydrate, and particularly upon lactose, for its rapid development. It might be reasonably assumed therefore that at a level where there would be alternate periods of carbohydrate and lack of carbohydrate there would be found bacteria whose metabolism would be equally well maintained in a medium in which carbohydrate would be present one time and absent later. Such an organism is indeed found commonly in the intestinal tract under these conditions, and it is represented to the extent of nearly 60 per cent. in the viable fecal flora. This organism is Bacillus coli and it grows rapidly in media containing carbohydrate and almost equally rapidly in media containing no carbohydrate. Time does not permit of an extension of the discussion along these lines because there are certain other aspects of gastro-intestinal bacteria which must be at least briefly mentioned.

Bacterial Implantation in the Intestinal Tract. Somewhat more than a decade ago, Metchnikoff published that very interesting but somewhat speculative book called *The Prolongation of Life*, in which he called attention to a possible parallelism between premature senility, that very indefinite condition spoken of as autointoxication and the possibility of microbic stagnation, leading to the overgrowth of bacteria which produced substances acting as cumulative poisons. To combat these somewhat hypothetical toxicogenic bacteria he proposed to infect the intestinal tract with lactic acid bacilli. Although many of the assumption on which this theory was based have not yet received confirmation, the concrete idea of bacterial implantation within the intestinal canal for therapeutic purposes opened a new and interesting field for study.

Very briefly the theoretical procedure was to introduce into the alimentary canal living cultures of suitable organisms which would colonize and through the formation of certain products—benign to the host but inimical to the bad microbes—restrict the activity of the latter or even drive them out. The organism selected for this purpose was Bacillus bulgaricus.

Observations made by different observers upon experimental animals have shown almost conclusively, however, that the Bacillus bulgaricus does not acclimatize itself readily in the large intestine, where the microbic cesspool is most active. If published observations are correct, Bacillus bulgaricus is an organism which for scores of years has been cultivated in milk outside of the human

body. It requires a great deal of courage to predict that an organism which has been cultivated exclusively outside of the body in milk for many years should be able all at once to adapt itself to intestinal conditions, and it is not surprising to find that the implantation of Bacillus bulgaricus has left much to be desired.

There is, however, an organism, or, more properly, a group of organisms, relatively common inhabitants of the lower intestinal tract of man, which possesses the requisite qualifications for development within the alimentary canal, and inasmuch as they are normal inhabitants of the region where colonization is desirable, these bacteria would appear to be the logical candidates for this type of therapeutics.

In order to be certain, however, that Bacillus acidophilus (for that is the name of the organism) will colonize successfully and certainly within the intestinal tract the mistake must not be made of keeping cultures of this organism too long upon artificial media before introduction into the body. That is to say, the artificial perpetuation of a strain of Bacillus acidophilus for long periods of time outside the human body may so modify its adaptability to intestinal conditions that it will not fulfil the purpose for which it is intended. Fresh isolations from the intestinal contents should be made as frequently as is necessary to ensure active acclimatizing strain. Failure to realize the importance of these relatively simple and perfectly obvious details has prevented the accumulation of a satisfactory literature upon the highly important practical aspects of bacterial implantation.

In addition to the obvious necessity of securing a suitable microbe for intestinal bacterial therapeutics it is equally essential to provide the proper food for the organism. The food for the organism is naturally that portion of the intestinal contents flowing through the section in which the microbes are growing. If the object of intestinal implantation is to restrict the putrefaction of protein derivatives—and this is usually the object sought for—it is perfectly obvious that a decided reduction in protein in the diet is an important initial step. The next step is to increase the carbohydrate of the diet, but it is imperative to ascertain if the carbohydrate in utilizable form actually reaches the desired area. If, for example, the reduction in protein and increase in carbohydrate is assured, but there exists a sluggish motility in the higher layers of the alimentary canal, the inevitable tendency is for the rather rapidly assimilated carbohydrates to be absorbed, leaving a residuum of protein derivatives, which are naturally hydrolyzed more slowly. Under these conditions, although the diet may appear adequate and correctly proportioned on the diet sheet, it may well happen that the amount of carbohydrate actually reaching the lower intestinal tract is so limited that the desired object of a continued supply of utilizable sugar is not realized. Enough has been said to suggest at least

the nature of the factors which must carefully be considered before accepting or rejecting the efficiency of bacterial implantation.

There are contra-indications to bacterial implantation and these may be theoretically of at least two classes. If the condition to be corrected is one which is associated with a relative intolerance for carbohydrates (and such conditions are not uncommon, although they are frequently not recognized), then clearly the administration of carbohydrate as such is not likely to be productive of the best results. On the other hand, there are occasional diarrheal conditions in the intestinal tract which are associated with, even if not caused by, an overgrowth of bacteria which are able to ferment large amounts of certain types of carbohydrate in an abnormal manner in a very short time. Some of these microbes, even in an artificial medium, may actually use up 5 per cent. or more of sugar within a period of a comparatively few hours: How much more active may these organisms be in the intestinal tract, where, generally speaking, conditions for their development may be much more favorable than in artificial cultivation! Experience has shown that under these two conditions, namely, where there exists an intolerance of carbohydrates and where there may be present an unusual number of fermentative bacteria in an active or latent state, which would act energetically upon a sudden increase in the carbohydrate in food, the best results are obtained by administering sour milk. Apparently, although proof is still lacking upon this point, the considerable amount of preformed lactic acid in well-soured milk spreads rapidly through the intestinal tract, because of the increased peristalsis which is usually a factor of such cases, and brings about chemical improvement, which may be rapid or slow, depending upon conditions. The organisms which exhibit unusual intestinal fermentative activity are, so far as is known at the present time, intolerant of lactic acid.

From what has been said it must be obvious that in theory at least there is a very close relationship between the diet of the host and the nature, extent and type of bacterial development which takes place within the alimentary canal. When the diet is monotonously rich in carbohydrate, so that the entire tract is permeated, as it were, continuously with sugars, the natural tendency is toward a great increase of bacteria whose fermentative activities are prominent. The products of growth of these organisms are not inimical to the host, as a rule. This is shown by the great preponderance of Bacillus bifidus in the normal nursling and the ability to encourage to a marked degree an aciduric flora in suitable experimental animals by carefully conducted feedings. When the diet of the host is so modified that there is no longer a preponderance of carbohydrate throughout the intestinal tract, then there becomes manifest a regional strata of microbes whose metabolism is accommodated to the ordinary fluctuations in diet. In those levels in which carbo-

hydrate is not continuously present and from which it occasionally disappears, it is not surprising to find that bacteria which accommodate themselves with almost equal readiness to media, with or without carbohydrates, become prominent. This is shown by the remarkable increase in colon bacilli in the intestinal contents of adolescents and adults. From the ileocecal valve onward the presence of carbohydrates is usually irregular and the colon bacillus consequently thrives better because of its adaptability in this respect than does Bacillus bifidus.

Bromatology and Bromatherapy. Certain theoretical therapeutic applications present themselves if the above observations are correct. Hundreds of experiments in artificial media have shown that the typhoid bacillus, dysentery bacillus and many other pathogenic bacteria produce substances akin to those characteristic of sour milk, when they are grown in the presence of utilizable carbohydrate, and products undoubtedly associated with the decomposition of proteins when carbohydrate is absent. In the case of the diphtheria bacillus the cultures in utilizable carbohydrate contain no toxin, whereas those cultivated under parallel conditions in media without carbohydrate produced considerable amounts of very potent toxin. Would it not be logical, in intestinal infections, as, for example, in dysentery or cholera, to attempt at least to flood the intestinal tract with considerable amounts of suitable carbohydrates and thereby provide the necessary non-nitrogenous pabulum for these organisms? Unless conditions within the intestinal tract are fundamentally unlike those in artificial media (an improbable supposition because the carbohydrate under discussion is a distinct chemical entity), it is reasonable to expect that some of the nitrogenous products formed by these bacteria may then be replaced by lactic acid and similar non-toxic fermentative substances; in other words, create dietary conditions within the alimentary canal potentially like those of a normal nursling and confidently hope for an analogous bacterial response. Of course the damage which may have resulted from the growth of pathogenic bacteria prior to the change in diet cannot be undone, but there remains the strong theoretical possibility of reducing, or even preventing, additional harm through this shifting of the metabolism of the invader by the utilization of carbohydrates for energy, with the resultant formation of definitely benign products.

It must be emphasized in passing that an occasional aberrant fermentative flora be not aroused to unusual activity by this change in diet. Fortunately, such cases are relatively uncommon and readily controlled if they are recognized when the change is made.

The researches of Coleman upon diet in typhoid fever have indicated that the high calorie diet, relatively rich in carbohydrate, does exert an influence upon the patient which is not fully explained on the assumption of sparing the nitrogenous loss of the body, due to

the fever and toxemia. The reduction in toxemia which is frequently observed will be explained in part at least by an absorption of carbohydrates from the intestinal tract, providing thus not only in the intestinal tract but in the tissues and blood as well a maximum amount of utilizable sugar. The tissues of the body are not called upon to furnish their own fuel. The normal blood contains not far from 0.08 per cent. of dextrose. A large carbohydrate intake would tend to keep the glycogen reservoir in the liver and possibly other organs at a high physiological level. The relatively small amount of dextrose used by the bacteria within the tissues would thus constantly be replaced. Coincidentally, the reduction of putrefaction and the accumulation of lactic acid formed not only by the pathogenic bacteria, but by normal intestinal microbes as well, would tend to lessen rather than to increase irritation from bacterial products formed within the alimentary tract. Coleman and his associates have actually found that the beneficial effects of feeding on this high calorie diet were rather more marked in those individuals whose intestinal tracts contained active members of the aciduric group, and they have reached the conclusion that an artificial implantation of Bacillus acidophilus may well be an important adjunct in the high calorie dietary treatment of this disease. The intestinal group of diseases, typhoid, dysentery, paratyphoid and cholera, would all appear to be amenable to this form of bromotherapy.

An hypothesis or theory developed in a growing subject which does not suggest more than it answers is a poor one indeed. In conclusion, therefore, a theoretical extension of the intra-intestinal aspects of bacterial metabolism, bacterial implantation and bromotherapy to abdominal, intestinal and rectal surgery may legitimately be considered. It is a matter of rather common observation that perforating wounds of the upper intestinal tract are, on the whole, less dangerous to the patient than similar lesions lower down. Various explanations have been advanced to explain this phenomenon, and emphasis has been placed upon the comparative paucity of microbes in the duodenum and upper stretches of the intestines. This is apparently true during interdigestive periods. There is, however, a rapid rise in the number of bacteria when food enters the upper levels which would indicate that the kinds of organisms or their activities might be of some importance as well.

From the view-point of alimentology it is an assured fact that carbohydrate will normally be present in the duodenal sector as the food passes through, and it is not surprising to find that the duodenal flora is, on the whole, relatively carbohydrophilic. The theoretical possibility of inducing a similar condition throughout the tract is in the realm of possibility, as is clearly shown in that great natural experiment in the nursling's alimentary canal. The two important factors to be considered in inducing an appropriate intestinal flora

as a preoperative measure are, diet and, in the lower intestine, bacterial implantation. It should be possible to assist the dietary factor materially in those instances in which carbohydrates in appropriate amounts do not reach the desired level by rectal administration, and this process readily admits of a simultaneous implantation of bacteria to assure a nucleus of desirable microbes upon which to build. Such a procedure can do no harm and the possibilities are decidedly in favor of the patient. If this is successfully carried out the dangers from intestinal infection should be materially lowered, a point of some theoretical importance to the surgeon.

SUMMARY. 1. There appears to be an intimate relationship between the character of the diet and the nature of the intestinal flora.

2. This relationship, bacterially considered, is manifested by an adaptive intestinal acclimatization of fairly definite types of bacteria. Changes in the diet, if prolonged, tend to change the types of bacteria. A change in the products of metabolism of intestinal bacteria is also induced, depending upon the presence or absence of carbohydrate. Positive implantation of adventitious microbes—those not accommodative to intestinal conditions—appears to be infrequent.

3. Bacteria which are normally acclimatized do not produce metabolic products widely at variance with the well-being of the host. Toxic or irritating metabolic products tend to arouse the antagonism of the host. The results may be disease, expulsion of the microbe, immunity or the carrier state.

4. Products arising from the utilization of food for energy by intestinal bacteria are of paramount importance in determining the specificity of action of these microbes. To a limited degree a careful modification of the diet may materially alter the character of these metabolic products, with benefit to the host. Bromotherapy may be practised in acute or chronic disease.

5. Bacterial implantation within the alimentary canal must follow natural lines. Bacterial acclimatization and adaptation is the resultant of complex reciprocal activities between host and parasite.

6. Intelligent bacterial implantation presupposes an accurate knowledge of the chemistry of the metabolic products of the bacteria under varying dietary conditions.

7. It is unwise to generalize from incomplete data. The data of bromatology and bromatherapy in relation to microbic activity in the alimentary canal are conspicuously incomplete. Nevertheless, the remarkable influence of diet upon the activities of intestinal bacteria, in so far as it is known, would warrant the assumption that a new chapter in the broad field of bacteriology has just opened. The indications are apparently favorable for a new avenue of approach to bacteriotherapy.

THE FREQUENCY OF PROTOZOIC ENTEROCOLITIS IN THE MIDDLE WEST: CLINICAL MANIFESTATIONS, DIAGNOSIS AND TREATMENT.[1]

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Study of the records of the last 1000 stool analyses in my clinic at Augustana Hospital indicates that therein 93 instances protozoa were observed. Inasmuch as the patients furnishing these specimens were largely from the northern half of the middle west—a region where man is commonly considered to be free from protozoic infection—it would seem not altogether valueless to review this material from its clinical aspects. Apart from those in tropical countries, but little mention of such findings exists in medical text-books. Vague, archaic descriptions of the parasites together with illustrations common to laboratory manuals for decades have been firmly engrafted on the mind, medical, throughout the country—and this in spite of the emphatic and complete articles by Darling, Craig, Deeks, Freund, Sistrunk, Lyons and Giffin. It would seem quite possible that the local and general increases in population and the ease with which people get from place to place is worth emphasis. The free intercourse between Mexico, South America, the Islands of the Far East and the Southern States of this country may be a not-to-be-neglected factor in a wider spreading of protozoic intestinal infections than has heretofore been recognized.

A. Etiological Factors of the Group. *Age.* The patients' ages ranged from seven years to eighty-two years. The average age was thirty-nine.

TABLE I.—CASES OF PROTOZOIC ENTEROCOLITIS IN THREE YEARS.

Patients with intermittent or chronic diarrhea	86
Patients without diarrhea	7
Total cases	93
Patients from south of Springfield, Ill.	4
Patients who had visited in the South	11
Patients who had never been in the South	78
Patients from small towns, rural communities or farms	70
City or large town dwellers	23
Patients who had habitually drunken well or shallow river water	78
Patients whose water supply was seemingly good	15
Patients who were large eaters of fresh garden truck, bananas or unwashed fresh fruits	66

[1] Read before the Chicago Society of Internal Medicine.

Sex. There were 51 males and 42 females. There was practically no difference noted in the sex-age figure.

Nativity. Fifty-two patients were of Scandinavian birth or extraction. The remainder were Americans, Germans, Irish, Russians, Austrians or English.

Geographic Distribution. During the past ten years we have had strongly impressed upon us the importance of gaining information when taking histories, regarding both the present and past residences of patients and also the exact environmental conditions under which they have lived. These points appear to have special significance in the examination of individuals affected with obscure abdominal ailments, particularly when such are associated with diarrhea.

The geographical diversity of patients forming this group was as follows: Illinois 29, Iowa, 16, Wisconsin 13, Nebraska 8, Michigan 7, Minnesota 6, Indiana 4, South Dakota 2, Arkansas 2, Ohio 2, Texas 2, Kentucky 1, North California 1. (Table I.)

It will be noted that but 4 patients came from regions south of Illinois. There were 11 patients who had made occasional business or pleasure trips to the Southern States. There were 78 individuals who had never been south of Illinois.

Water Supply, etc. We routinely seek information not only with respect to the patient's present drinking-water, but also regarding his drinking-water from childhood. The importance of water supply as a source of protozoic infection has been abundantly commented upon in the literature; clinically, we have gained valuable facts from seeking information about it. Not rarely patients admit that for years their drinking-water has been bad, especially such patients as have taken up residence in recently opened "homestead" territory. Shallow, dug wells, contaminated springs, sluggish, weed-grown rivers or ponds or lakes befouled by drainage systems have proved to be the source of water supply in 78 instances. In the remaining 15 cases the drinking-water was seemingly good.

The contamination of garden vegetables by dung is not unlikely responsible for protozoic spread. It is well known that hogs, cattle, sheep, barnyard fowls or snails, worms and flies are common carriers of flagellate protozoa and ameba in their intestinal canals. Instances in which cholera-form epidemics have existed on stock farms are not unknown to veterinarians. It is the usual practice to "fertilize" fields or boxes with "rich" manure in which head lettuce, radishes, tomatoes, mushrooms, celery, etc., are grown. One cannot deny that those who partake largely of these vegetables, raw and often carelessly washed, are in danger of ingesting both active and spore forms of protozoa. Of late years truck farming has become an important industry about every big city—hence the army of "manure-eaters" is not located wholly in the country. City folk who are financially able to afford the luxury of fresh

garden truck may be contaminated during the entire year. The common house-fly not infrequently contaminates fruits, particularly the banana. This fact is well known to Mexican planters who have cleared areas previously endemic with amebic dysentery, by the simple procedure of screening the banana sheds and covering dung mounds with antiseptics, sand or oil. It is quite possible that the prevalence of protozoa in the mouths of individuals in both tropical and temperate countries is due to food and water contamination. These parasites live in filth; if the filth is supplied in the mouth by eroding gums and decaying, dirty teeth (as in pyorrhea) the parasites may thrive and do harm. Soggy tonsils, cancerous, syphilitic, phagedenic or tuberculous ulcers likewise furnish an ideal camping-ground for these unwelcome guests. If the hydrochloric acid of the stomach did not inhibit or destroy these parasites it is not unlikely that intestinal infection would be more universal. What controlling effects digestive enzymes, bile salts or intestinal flora have on these organisms is not known. The mechanical activity of the stomach, duodenum and jejunum may prevent lodgment and multiplication in these parts of the gut, while the stagnation and increased bacterial proliferation of the terminal ileum and of the large bowel may furnish from time to time the proper habitat for protozoic lodgment and growth. That protozoa may exist for a long time without causing symptoms is evidenced by Willets' report that 85 per cent. of all Philipinos habitually harbor these parasites and that but intermittently (spring and summer) do they enormously multiply and produce local and systemic effects.

Of our 93 cases, 66 patients were consistent eaters of fresh garden truck, unwashed fresh raw fruits or bananas.

B. Clinical Symptomatology.

TABLE II.—DIARRHEA PATIENTS.

Duration.	
Less than one year	8
Between one and three years	27
Between three and five years	31
Between five and ten years	12
More than ten years	8
Total cases	86

Attacks of diarrhea—Least number	3 in all
Maximum number	9 yearly
Diarrhea, chronic and continuous (summary of 72 cases)	14 cases

1. *Diarrhea.* In our series this was a presenting complaint in 86 cases. Diarrheic stools without frequent evacuations were not rarely passed chronically, with periods when the movements were frequent. The *intermittency of frequent diarrheic stools, with apparently normal motions in the intervals is quite characteristic of this affection* and aids in differentiating it from the diarrheic stools asso-

ciated with gastric or pancreatic achylia, imperfect liver function, tuberculous or luetic ulceration of the bowel and the like in which ailments the *constancy* of the soft or fluid stools is a common observation. In the event of the diarrheas associated with protozoa, the patient may note no change in his habit, mode of life or diet, but quite suddenly may experience frequent evacuations of the bowels. Occasionally a period of severe mental or physical overstrain or an attack of la grippe, tonsillitis or the like are stated as preceding the diarrhea. The attacks may be infrequent or may come close together over a period of many years. The latter event may supervene upon the former. In our series one patient had had but three attacks, while another case had experienced nine in one year. There were 14 patients in whom the diarrhea had been continuous.

The duration of the diarrhea varies greatly. (See Table II.) Sixty-seven per cent. of our cases had been affected from one to five years; 8 cases had been ill less than one year, while a like number had been ailing for more than ten years; the longest period being forty-three years.

TABLE III.—SUMMARY OF CLINICAL SIGNS AND SYMPTOMS.

(Figures Stand for Number of Cases.)

Clinical observation.	Parasite.					
	Ameba.	Cercomonas.	Trichomonas.	Lamblia.	Megastoma.	Balantidium.
Diarrhea	24	33	20	5	2	2
Constipation	1	2	0	0	0	0
Normal stools	2	1	0	0	0	0
Abdominal pain	21	30	17	4	2	1
Dyspepsia	15	28	21	5	1	2
Weight loss	17	30	21	3	2	2
Achylia gastrica	13	12	11	2	1	1
Subnormal acid	8	14	8	2	0	1
Normal gastric acid	6	10	2	1	1	0
Anemia	26	31	18	4	2	2
Eosinophilia (above 3 per cent.)	19	27	15	2	1	1
Blood in stools	14	17	16	3	2	2
Fever	4	1	2	0	0	0
Chill	2	3	2	1	0	1

In character the diarrhea is commonly of the gassy type, without discomfort upon the passage of the stool. Occasionally an associated inflammatory change in the colon, especially in the sigmoid or rectal sections, results in painful evacuations. Hemorrhoids were present in 38 per cent. of our cases. They may become extremely annoying when the motions are very frequent and watery.

The bowel movements are generally easy, but prolonged diarrhea may lead to marked tenesmus and prostration.

Constipation occurred in 4 of our cases, in fact, the most toxic patient appeared for the relief of an obstinate intestinal stasis. Routine examination of the freshly passed stool following saline catharsis disclosed enormous numbers of entamebæ in the histolytica stage and actively motile cercomonads.

2. *Dyspepsia.* This was a prominent complaint in 75 cases (75 per cent.). The dyspepsia was generally associated with nausea (particularly in the morning), eructations of foul gas, regurgitation of sour-food mixtures (even when the stomach analyses revealed absent or low gastric acid), gassy distention of the abdomen, soreness after eating, loss of appetite and occasionally vomiting.

3. *Abdominal Pain or Discomfort.* Abdominal pain or discomfort was a complaint in 89 instances (95.6 per cent.). The discomfort was variously described as colicky (like gas pains following abdominal exploration), soreness, distention, cramp-like, "dragging" or vague "weak feelings." Sometimes the rapid peristaltic movements of the small gut were productive of an annoying discomfort even though actual pain were absent.

4. *Weight Loss.* This was noted in 75 cases (80 per cent.). The loss varied from 5 pounds to 104 pounds. The average loss was 17.3 pounds. Some weight losses were so striking and so rapid as to bring the patient under observation for suspected, atypically located malignancy: a young woman affected with entamebæ and cercomonads lost 104 pounds in less than one year; a middle-aged woman lost 80 pounds in less than fifteen months; a man, aged eighty-two years lost 65 pounds in less than ten months. With the exception of the first case these patients nearly doubled their weights during the year following treatment. The first-mentioned female gained 28 pounds within three months of her discharge from the hospital.

5. *Strength Loss.* Strength loss is often striking even though the weight may have decreased comparatively little. Apart from the possible toxic effect of the protozoic infection, loss of sleep due to diarrhea, imperfect assimilation or diminished quantity of ingested food, continuous abdominal discomfort, anemia and the dread of the existence of an incurable ailment seem to be important factors in the production of a general, systemic weakness.

6. *Anemia.* Anemia is usually evident even though in some cases it may not be pronounced. It is sometimes of a grave degree: certain patients are sent in as pernicious anemia cases or as atypical anemias of unknown etiology.

7. *Mental Attitude.* A peculiar malaise of melancholia is frequently observed. It may be due to a dread of impending evil, continuous headaches (especially common in some instances), weakness, anemia, loss of sleep, abdominal distress or toxic substances occurring as a consequence of the bowel upset.

C. Physical Examination.

The patients generally appear both starved and toxic; in this respect the individuals past middle age closely resemble those with malignant disease. The skin often exhibits a dusky sallow pallor. It is not rarely dry and wrinkled. Subcutaneous fat is lost quite early, although not so early as in malignant disease. There is liable to be edema about the ankles in the severe cases. The visible mucosæ are generally pale, dry and scaly. The saliva is often scant and tenacious. The tongue is usually swollen, marked by the teeth and heavily coated. The breath is heavy and often foul. Focal infections about the nasal passages, teeth and tonsils are not uncommon, but such are not characteristic for this affection.

Thoracic examination often discloses shallow respirations of increased rate, and when weight and strength loss have been rapid such are associated with anemia, signs of lung edema. The heart rate may be slowed, but upon exertion it increases out of reasonable proportion to the amount of exercise. Murmurs, generally systolic, are not uncommon in such cases.

Abdominal inspection revealed visible peristalsis over the small bowels in 22 of our patients (23 per cent.). The waves were often strikingly visible and of very rapid rate. In several instances peristalsis was seen only following sharp tapping of the belly wall with the fingers. Patients had sometimes felt the actively moving small gut and were under the impression that snakes, tape-worms, etc., had developed within them.

Palpation usually made out both small and large bowels filled with gas and feces. This was a common observation in the diarrhea cases. Distention of the terminal ileum was frequently pronounced —the coils felt as large as loops of normal colon.

Tenderness over the small and large gut was noted in 64 cases (69 per cent.). In severe diarrhea it was often marked. Tender areas over the gall-bladder or appendix zones was present in 83 instances (88 per cent.). The liver was enlarged and tender in 3 patients. The spleen was palpable 9 times: in 4 there was definite enlargement.

Rectal Examination. The frequency of hemorrhoids has already been commented upon.

Proctoscopic examinations were made in the last 37 cases coming under observation. Bleeding ulcers were noted in the sigmoid or upper rectum 9 times. In 21 cases a diffuse, catarrhal or granular inflammation of the gut was seemingly of greater grade than the frequent bowel evacuations alone would explain. In these cases the bowel was easily traumatized and in some instances the bleeding following instrumentation was rather severe.

D. Laboratory Examinations.

1. *Stools.* For the detection of protozoa it is absolutely essential that the stool be properly collected. Our procedure is as follows:

Any medicines which the patient may have been taking are stopped. He is then placed upon a liquid diet for thirty-six hours. At the expiration of this period he comes to the clinic. He is given 1 ounce of Epsom salt or 500 c.c. solution of citrate of magnesia upon an empty stomach. The first stool passed is discarded; the second or subsequent stools are collected in a warmed container, mixed with one-fourth volume of warm normal saline solution and examined at once, by high power, in thin smears placed upon warmed glass slides on the hot stage of a microscope. None of the ready-made warm stages are satisfactory. After trying all forms we have come back to the copper plate heated by a Bunsen microburner placed upon the ordinary microscope stage. If such is not at hand an old-time carbon electric bulb placed beneath the microscope stage after the Abbe condenser has been swung to one side answers very well. In suspected cases examination is made of at least six slides before negative opinion is given. Very often examinations are made daily for even as long as a week when the history is suggestive. Frequent examinations of different stools often not only detects parasites that might have been missed but leads to the discovery of multiple infections. High power should be used in the examinations, particularly for entamebæ, because the differentiation of the types may rest upon careful study of cellular architecture. Stained specimens are best prepared by the Hastings-Giemsa method suggested by Darling.[2]

2. *Macroscopic Examination of Stools.* The stools are commonly of a greenish-brown or yellow color and of a purée-like consistency, intermixed with flakes of mucus and food bits. They may be blood-streaked or foamy. The *reaction* is usually definitely alkaline. The odor is often quite characteristic: a peculiarly penetrating, pungent mustiness that sometimes is definitely ammoniacal. When there is much blood or necrotic tissue the foul, acrid, putrid odor is disgustingly nauseating.

[2] Fresh coverslip preparations containing a sufficient number of entamebæ to warrant staining and study, or those intended for diagnosis, are made into smears by sliding off the cover slip and thoroughly drying both slip and slide, after which each is stained with Hastings's stain for fifteen minutes. Satisfactory films are then overstained with Giemsa's stain until the film has a diffuse reddish purple tint. The film is then plunged into 60 per cent. ethyl alcohol containing about 1 per cent. of water of ammonia (10 per cent.), and differentiated in this, washed in water, and controlled by the microscope until the purple substance of the nucleus and the blue color of the cytoplasm are strongly contrasted. The film when properly differentiated has a blue-violet color. If the film has been greatly overstained, it is treated with a momentary douche of 95 per cent. alcohol. Beautiful pictures are obtained in this way, but, what is of more importance, the various figures displayed by the purple staining substance (karyosome?) can be noted and followed with ease. This purple staining substance, in the nucleus of Entameba tetragena in dried-fixed films, represents only a portion of the nucleus, as the centriole and peripheral chromatin do not stain purple by the above method. The purple staining substance in the nucleus of Entameba tetragena frequently appears as a ring, or as a reticulum, or scattered granules.

3. *Microscopic Study.* The most striking feature of the stools, apart from the parasites, lies in the presence of enormous numbers of large and small, motile and non-motile bacilli or spirillæ. Indeed, such great numbers of bacteria often urge one on to examination of many specimens for protozoa when the first slides have proved negative. Frequently the bacteria are so numerous as to resemble a hanging-drop from a bacterial culture.

In addition to bacteria are generally noted actively budding yeasts, chains or groups of cocci or of torulæ, scattered collections of mucous corpuscles or leukocytes and occasional, usually partly degenerated, red blood cells. In some smears, ammonium triple phosphate crystals and leucin plates and fatty acid needles are often very abundant. There are generally considerable undigested vegetable tissue and partly broken-up muscle bundles when the patient has been on a fairly full diet.

4. *The Protozoa.* As already stated persistent search is often necessary before the organism can be properly seen and identified. This applies particularly to entamebæ; the flagellates are readily recognized by one with the common training in parasitology. There is still considerable debate respecting the identity of entamebæ histolytica and tetragena. We have followed the classifications of Darling and of Craig in considering the cellular variations to represent different stages of the same organism. The histolytica stage appears to represent the organism at its maximum of activity and probably pathogenicity.

In our series of cases the incidence of the protozoa was as follows:

TABLE IV.

Cercomonas intestinalis hominis	36
Trichomonas intestinalis hominis	21
Entamebæ—Histolytica stage	17
Tetragena stage	6
Unclassified	4
Entamebæ total	27
Lamblia intestinalis hominis	5
Megastoma entericum	2
Balantidium coli	2
Grand total of cases	93

COINCIDENT INFECTIONS.

Cercomonas with entamebæ	12
Trichomonas with entamebæ	14
Cercomonas, trichomonas and entamebæ	4
Trichomonas and cercomonas	8
Cercomonas and lamblia	3
Cercomonas, trichomonas and lamblia	2
Trichomonas, cercomonas and megastoma	1
Trichomonas and balantidium	2

5. *Chemical Examination of the Stools.*

(*a*) *Blood.* Altered blood was demonstrated in 74 instances (79 per cent.) by the benzidin test.

(*b*) *Pancreatic Efficiency Tests.* Quantitative estimation of trypsin and amylase was made by the methods of Gross-Fuld-Wohlgemuth in 29 cases. In 22 instances (76 per cent.) trypsin was reduced below the normal (500 units). In 9 instances (31 per cent.) amylase was deficient.

(*c*) *Bile Pigment.* By the Schmidt bichloride test made upon stools from 46 individuals, bilirubin was present in 32 (69 per cent.) and biliverdin in 14 (30 per cent.).

6. *Gastric Analyses.* It is not infrequently stated that when protozoa are found chronically in the stools of patients of the temperate zone, such are secondary contaminations due to gastric achylia. It has not been shown why if such be the case there should not be a more universal finding of protozoa in the great group of achylias that come under observation. It is not unlikely that the rapid multiplication of protozoa and symbiotic bacteria in the intestinal canal is capable of bringing about toxic gastric or pancreatic achylias. Similar occurrences have been noted in association with typhoid fever and pellagra in our clinic and in cholera and intestinal tuberculosis by others.

In our series there were 40 cases (43 per cent.) with gastric achylia; 33 cases (36 per cent.) and subnormal hydrochloric acidity and 20 cases (21 per cent.) with normal or increased gastric HCl. In one instance of most pronounced acute infection with cercomonads and trichomonads the free HCl was 86.

The gastric motility was normal in 83 cases (89 per cent.). In 10 cases (10 per cent.) there was mild stagnation.

7. *Anemia.* In 19 instances this was sufficiently striking to suggest pernicious anemia. Study of numerous blood counts and films failed, however, to establish the disease. The characteristic anemia is of secondary type, such as is common in chronic intoxications, namely, nephritis, cancer or malnutrition. The average *hemoglobin* was rather more than 70 per cent. The average red cell count was 3,120,000. The average white cell count was 8400. The *differential counts* revealed no great abnormality apart from the tendency of the small lymphocytes to increase at the expense of the polynuclears and, in some instances, a rather high percentage of eosinophiles. There were 69 cases (74 per cent.) where the eosinophile percentage equalled or exceeded 3. There were 11 instances where it ranged between 8 per cent. and 14 per cent. In 1 case the eosinophiles reached 18.5 per cent. (an instance of amebiasis and trichomoniasis). The blood counts are liable to show higher eosinophile counts before purgation than afterward. It was not observed that blood from cases presenting clinical signs of grave intoxication gave the highest eosinophile counts: in fact the most

pronounced eosinophilias were recorded in young individuals who had presented symptoms of protozoic infection for but a few years.

8. *Urine.* In 16 instances albuminuria was noted. It is not possible to state that this finding was directly due to the presence of parasites. Many of the cases were at the age in life when traces of albumin are quite commonly found in the urine.

E. TREATMENT.

1. *General.* It is important that all local infection foci (teeth, tonsils, mouth or throat ulcers, diseased gall-bladders or appendices, etc.) should be removed before attack is made upon the intestinal infection. If such are not taken care of radically, reinfections may occur or subsequent ailments of such parts may lower general resistance sufficiently to again permit of enteric infection by protozoa. Encysted protozoa may lurk for years in the appendix or the gall-bladder. When such is the case the host is to be considered a not altogether harmless carrier.

2. *Measures to Free the Intestine of Protozoa.* A preliminary preparation of the intestinal canal enables one to quickly bring about its sterilization. In my clinic these patients are placed upon a liquid diet for two days before medical care is begun. This permits of the bowel being freed from firm residues. Each morning they receive a glass of citrate of magnesia solution. *The aim of specific medicines is to render inert protozoa infecting the intestinal contents and thus prevent infections of the mucosa and to destroy organisms already lodged within the mucous membrane.* Successful therapy depends upon proper isolation of the infecting parasites: entamebæ are particularly susceptible to ipecac or its alkaloid, emetin, while flagellate or ciliated protozoa are slightly affected by these drugs but are readily destroyed by calomel. Thymol is effective against both parasites.

(*a*) *In the entamebæ cases* the patient is put to bed on liquid diet, with hot pads moistened in boracic alcohol mixture over the abdomen (to prevent colicky pains or abdominal discomfort). He is then given by mouth a 10-grain tablet of the aluminum salicylate of ipecac ("alcresta") every hour and $\frac{1}{3}$ grain of emetin hydrochloride hypodermically every four hours for two days.[1] If the stools show diminution of the parasites the dose of ipecac and emetin is then reduced by one-third and this continued for another two-day period. No reduction is made if the parasites are still very abundant or are very active. Usually by the end of the first week the patient is taking 1 to 2 grains of emetin hypodermically daily and 10 grains of ipecac ("alcresta") four times daily. The treatment is continued even when no parasites are seen. Accompanying the medicines given by mouth the colon is carefully lavaged with 4 quarts of hot normal salt solution or a solution of quinin, $\frac{1}{3000}$, and thymol,

[1] We have also administered ipecac in the form of salol-coated pills (as suggested in 1903 by Dock), wine of ipecac by the duodenal tube (after Beck's method), and recently 1 to 3 ounces of wine of ipecac directly into the colon *per rectum*. The last procedure seems to offer a therapeutic regime of much value in severe cases.

$\frac{1}{6000}$, in normal salt solution night and morning. On the sixth day the patient is put on fat-free diet for twenty-four hours (to render thymol administration safe). At bedtime of the seventh day 30 grains of thymol in honey are administered at 8 P.M., and again at 10 P.M. At 6 A.M. the following morning the patient gets 2 ounces of Epsom salt in hot water and all that morning frequent drinks of black coffee, fat-free broth or malted milk. During the second week the emetin, ipecac and bowel irrigations are continued, and usually on the tenth day from the beginning of the treatment two doses of 15 grains each of thymol (preceded by twenty-four hours of fat-free diet) are given in the evening. Daily examinations of the warm stools usually indicate no parasites by this time and the diet may be increased according to the patient's desires, provided it is low in protein and not very bulky. If parasites persist at the end of two weeks, then after thorough colon lavage with hot normal saline solution, from 500 to 1000 c.c. of filtered, commercial kerosene are given per rectum, slowly. The external parts are greased with carbolated vaselin and effort is made to have the patient retain the kerosene for at least one hour. We have never seen any harmful effects follow the use of kerosene. It has proved very efficacious in ridding the bowel of persistent infection.

When the entamebæ are no longer demonstrable in the freshly passed stool, then local treatment of the enterocolitis by large doses (30 grains) of bismuth subnitrate or subcarbonate given five times daily should be carried out. Emetin and ipecac should be continued for at least five weeks, the ipecac alone for three months. The bowel irrigations are usually stopped at the end of the third week. The general state of the patient is taken care of according to indication: HCl after meals if the gastric juice is lacking in acid; iron and arsenic if anemia is present.

(*b*) When *flagellate protozoa* are the infecting organism the treatment is substantially as outlined above for entamebæ except that emetin and ipecac are not used unless there is a concomitant amebiasis. The flagellates are readily destroyed by the administration of evening doses of calomel (5 to 15 grains) followed by 2 ounces of Epsom salt the next day. These doses of calomel are repeated about every five days, according to the indications furnished by the stool examinations. The flagellates are usually less persistent than are the entamebæ with the exception of lambliæ.

(*c*) *After-treatment.* Our study of specimens of gall-bladders and appendices removed at laparotomy indicates that in these parts of the gut cysts of protozoa may lurk for years. Reinfection of the bowel is thus possible. Consequently if these organs have not been removed we insist that our patients have stool examinations at least three times a year and that they go through an abbreviated course of treatment similar to that above outlined. Only in this way do we believe that protozoa "carriers" can be eliminated or reinfection of so-called cured cases prevented.

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EFFECT OF STIMULI FROM THE LOWER BOWEL ON THE RATE OF EMPTYING THE STOMACH.[1]

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It has been shown by Cannon[2] and others that irritation of the colon may delay the emptying of the stomach. This is striking and well known when powerful stimuli occur, as in intestinal injury, in cutting, drying or handling the bowel. Here there is a definite protective mechanism holding back food above until some measure of healing occurs below.

Some men have also emphasized the effect of distention or irritation of the lower bowel by enemata, stasis in the ileum, inflammation of the appendix, adhesions in the ileocecal region, etc., in causing the stomach to empty slowly (Hirsch,[3] Alvarez,[4] Baumstark,[5] Jordan,[6] Eisen,[7] Smithies,[8] Barclay,[9] Cole,[10] Ochsner,[11] Borbjarg[12]). We have studied a group of such cases to find out how frequently this occurs and what sort of irritation gives this result. We have a series of clinical observations and also of animal experiments.

[1] Read at the thirty-second Annual Meeting of the Association of American Physicians, Atlantic City, May 2. 1917.
[2] The Mechanical Factors of Digestion, London, 1911.
[3] Centralbl. f. klin. Med., 1893, xiv, 377.
[4] Jour. Am. Med. Assn., 1915, lxv, 388.
[5] Ztschr. f. physiol. Chem., 1910, lxv, 484.
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[7] Jour. Am. Med. Assn., 1914, lxiii, 1228.
[8] Am. Jour. Med. Sc., 1915, cxliv, 187.
[9] The Alimentary Tract, New York, 1915.
[10] Am. Jour. Med. Sc., 1914, cxlviii, 109.
[11] Ibid., 1906, cxxxii, 1.
[12] Arch. f. Verdauungskr., 1911, xvii, 706.

Our results all point definitely the same way. (1) Regarding *frequency*, delay in emptying the stomach is the exception, not the rule, in lesions of the lower bowel; (2) regarding the *kind of irritation*, a strong stimulus is needed from the lower bowel to slow the stomach.

TECHNIC OF OBSERVATIONS. We judged the time of emptying the stomach by watching the progress of a barium meal with the roentgen rays and fluorescent screen in men and cats. A carbohydrate meal was chosen because it favors prompt emptying of the stomach; we used potato gruel, mixed with barium sulphate, in the proportion of 100 gm. of barium to 500 c.c. of gruel. We gave a 500 c.c. meal to the men and 25 c.c. to the cats and studied the residues in the stomach after five or six hours in men and after two or three hours in cats.

We tried to avoid other factors causing delay in emptying the stomach, such as emotion, trauma, etc. For example, we might expect that fastening a cat to a holder, giving a meal by the stomach tube and then a rectal injection would produce such unpleasant emotions that observation on the time of emptying the stomach would have little value. We used elderly female cats and found that with a little practice these things could be deftly done within a few minutes, and the psychology of these cats is such that, if kindly treated, they were purring and contented within a minute or two after release from the holder. For later roentgen-ray examinations no holder was needed.

Operative trauma, the use of a fistula or injections through the peritoneum into the bowel were avoided by simply passing a catheter per rectum through the colon up to the cecum and making injections through this; with the colon empty and a catheter of proper size and flexibility (No. 16 French) this is easily done under the fluorescent screen. Irritants to be injected were usually mixed with a little barium sulphate and the injection also made under the fluorescent screen to control how much was given and exactly where the injection was placed.

THE EFFECT OF MECHANICAL FILLING OR DISTENTION OF THE COLON. The men were given by mouth 500 c.c. of barium potato gruel. The cats were fed by the stomach tube with 25 c.c. of the gruel. The cats were released at once and were not examined for two or three hours. In men bland rectal injections of 1000 to 1500 c.c. of potato gruel were given and retained as long as possible—usually from one to one and a half hours. In cats a similar rectal injection of 30 c.c to 40 c.c. was used.

This had little or no effect upon the emptying of the stomach. Food passed steadily through the pylorus while the enema was retained and the stomach was entirely empty within the normal period in each of the 10 cases in which this was tried. The only effect was a slight delay in the action of the stomach for the first

few minutes. This does not agree with the statement of Alvarez that introduction of food at the lower end of the digestive tract markedly retards the progress of material coming down from above.

The fact that patients occasionally vomit after rectal feeding is poor evidence of reflex action from the colon to the stomach, because rectal feeding is usually given on account of *previous* vomiting in gastric ulcer, stenosis, etc., and the fact remains that most patients do *not* vomit after rectal feeding.

THE EFFECT OF STASIS IN THE ILEUM. Out of a group of more than 200 patients in whom roentgen observations were made six and twelve hours after a barium-potato gruel meal, there were 42 without important lesion of the stomach whose small intestines emptied slowly and who had residue in the ileum at the end of twelve or more hours. In 16 the twelve-hour ileal residue was large, in 3 cases, persisting until nineteen, forty-eight and fifty-four hours respectively, in 18 was moderate and in 8 small; the lesion was chronic appendicitis in 20; adhesions of the ileum or colon in 20; atony and ptosis in 10; diseases of the gall-bladder in 2.

Only 4 of these cases showed any delay in emptying the stomach as measured by a six-hour residue.

In 2 the stomach residue at the end of six hours was very small and both were delicate women over seventy years, in whom a slight delay was not remarkable. The other 2 with good-sized residue showed slight deformities near the pylorus, which we interpreted as possible adhesions or spasm.

In short, in nearly all the cases which showed definite or marked delay in emptying the small intestine the stomach emptied promptly. This does not seem to support Barclay's theory of an ileopyloric reflex from the last coils of the ileum to the pylorus to shut off the food supply by closing the pylorus until the ileum is more empty.

The pyloric spasm seen by radiologists in chronic appendicitis is variable and uncertain and has little constant effect on function, the more chronic and quiescent the appendix the less likely it is to cause delay.

Smithies found persistent gastric retention in only a little over 3 per cent. of pyloric spasms associated with appendicitis and cholecystitis; intermittent retention was frequent and usually disappeared after removal of the appendix or gall-bladder.

EFFECT OF CHEMICAL IRRITATION OF THE BOWEL. This was tested in cats in the following way: In order to produce irritation in the cecum without any other trauma to the bowel a well-oiled rectal catheter was passed up the colon to the cecum and the irritant injected with a syringe. The short, simple colon of the cat makes it easy to pass a catheter, and its exact location was shown with the fluorescent screen. Barium sulphate was mixed with the injected material so that the amount and place of the injection could be seen.

Twenty-five successive experiments with two different cats showed

that injection of turpentine oil, either a few drops or ten drops or 2 c.c., caused no delay in emptying the stomach. The same result was obtained with a few drops of croton oil. Injection of 4 or 5 drops of mixtures of mustard oil and olive oil gave varied results: in 4 instances the cat vomited the whole contents of the stomach promptly after the injections, in 4 cases the injection slowed the emptying of the stomach, evidently in proportion to the strength of the mustard oil and the irritation produced in the colon: that is, the emptying time of the stomach was delayed from the normal two or three hours to five or six hours. In striking contrast to this, active irritation of the cecum with mustard oil caused *just as often* rapid downward emptying of the stomach and the whole digestive tract both above and below the irritated point.

We may grade the results roughly according to the degree of irritation of the cecum.

1. Intense irritation caused prompt reverse peristalsis in the stomach, with vomiting of its whole contents.

2. Marked irritation caused either (*a*) delay in emptying the stomach up to about twice the normal time, evidently due to spasm of the pylorus, or (*b*) hyperperistalsis and rapid emptying of the stomach and the whole digestive tract.

3. Moderate or slight irritation had no effect on the emptying of the stomach.

We did not get a perfect gradation of results, evidently because of the part played by spasm, which was very variable.

Clinical Data in Disease of the Lower Bowel. Data in the following group of intestinal cases show that delay in emptying the stomach after a barium meal is the exception not the rule. We need to be careful in studying such a group to allow for some delay due to ptosis and atony of the stomach, which often occurs in thin, weak or old people:

In 7 cases of chronic colitis there was no delay in emptying the stomach. In 3 cases of tubercular ulceration of the colon there was no delay and the diseased part of the bowel was so irritable that the barium meal passed through it very rapidly and it appeared empty. This is typical of this disease.

In 5 cancers of the colon, causing more or less obstruction, 2 of the cecum and ascending colon, 2 of the transverse colon and 1 of the sigmoid, there was no delay. In 1 case of chronic intussusception of the ileum one foot above the ileocecal valve there was no delay. Borbjarg in studying tumors of the ileocecal region and colon (using the residue six hours after a Riegel meal to test gastric motility, possibly an overdelicate test) suggests that tumors below the cecum do not delay stomach emptying and that tumors in the ileocecal region frequently do.

We have seen that in 42 cases with ileal stasis occurring in chronic appendicitis and adhesions of the ileum and colon only 4 showed any

delay in emptying the stomach. In an additional group of 53 cases, 27 with clear evidence of chronic changes about the appendix, 26 with adhesions of the ileum, cecum or colon, there were only 3 which showed any delay in emptying the stomach; 1 was a case of chronic appendicitis and 2 adhesions. There was 1 medium and 2 small five- to six-hour residues.

We had little chance to study acute appendicitis because early operation is usually needed. Two out of 8 cases of acute and subacute appendicitis showed slight delay in emptying the stomach, namely, a small six-hour residue, with the stomach empty at the end of seven or eight hours. This was not conclusive, as we obtained the same result in several other fever cases, with pain in which the bowel was not involved. Our experience with chemical irritants of the cecum suggest that different degrees of inflammation of the appendix may affect the stomach in a corresponding way by causing vomiting or delay in emptying or rapid emptying, though we have not been able to prove it.

Peritoneal involvement is important. Compare the definite effect on the stomach which Cannon[13] got by performing a laparotomy and injecting croton oil into the cecum by needle through the peritoneum; with the lack of effect we obtained by avoiding the peritoneum and injecting the croton oil by catheter. The element of pain is important—even such a simple lesion as fissure of the anus, if very painful, may cause delay and a good-sized six-hour residue in the stomach.

In a total of 120 cases of lesions of the lower bowel there were only 9, or 7.5 per cent., which showed any delay in emptying the stomach. Several of these cases were old and weak and some delay might be expected independent of reflexes from the lower bowel.

Clinical and experimental observation in lesions and irritation of the *upper* bowel (duodenum and jejunum) have shown that they often delay emptying of the stomach; they are outside the scope of this paper.

In conclusion, there is evidently a definite correlation of upper and lower parts of the digestive canal by a protective mechanism which works under a powerful stimulus, such as intestinal injury or surgery or intense irritation, but which does not work under a moderate stimulus or simple mechanical condition. The action of this mechanism is complicated by the contrary results of spasm and hyperperistalsis.

Evidence indicates that the delay in emptying the stomach is the result of impulses through the vagus causing pylorospasm, not inhibition of the motor fibers of the stomach through the splanchnic nerves.

The delay in emptying the stomach caused by spasm of the pylorus is very variable, present one day and absent the next, under similar conditions; in general, *marked delay* in emptying the stomach

[13] The Mechanical Factors of Digestion, London, 1911.

is far more often the result of actual lesions about the pylorus than of reflexes from the bowel.

It is not fair to compare the intestine to a railroad under a block system, where delay low down the line regularly holds up food for several blocks above or to say that "an irritating lesion slows the progress of food coming toward it from above." It may or may not do so, depending on the character and degree of the irritating lesion. It is evident that "stomach symptoms" in intestinal cases are not the result of slow emptying of the stomach, as a rule, but are largely toxic or the result of referred pain or distress.

SUMMARY. The roentgen-ray method was used to study the effect of stimuli from the lower bowel on the rate of emptying of the stomach; the effect of mechanical filling and distention of the colon by enemata in men and cats; the effect of chemical irritation of the cecum in cats; the effect of diseases of the lower bowel in 120 cases of chronic colitis, tubercular ulceration and cancer of the colon, chronic and acute appendicitis and adhesions of the lower ileum and colon.

Our results all point the same way: (1) delay in emptying the stomach is the exception, not the rule, in lesions of the lower bowel; (2) a strong stimulus is needed from the lower bowel to slow the stomach, for it was found that the stomach emptied a barium meal within the normal time in some cases of ileal stasis of two or more days' duration, and in most cases with good-sized twelve-hour residue in the ileum, also when the colon was distended with a large enema, also in most cases of chronic appendicitis and chronic inflammations and tumors of the colon.

Experiments on animals showed that when the colon was irritated by injections into the cecum variable results were obtained; intense irritation caused vomiting; less marked irritation caused either delay in emptying the stomach up to about twice the normal time or rapid emptying of the stomach and whole digestive tract; moderate or slight irritation had no effect. The results were not perfectly graded, evidently because of variable spasm.

There is evidently a definite correlation of different parts of the the digestive canal by a protective mechanism which works under a powerful stimulus, such as intestinal surgery or injury or strong irritation, but which does not work under a moderate stimulus or simple mechanical condition. The action of this mechanism is complicated by the contrary results of spasm and hyperperistalsis.

Marked delay in emptying the stomach is far more often the result of actual lesions about the pylorus than of reflexes from the bowel. "Stomach symptoms" in intestinal cases are not, as a rule, the result of slow emptying of the stomach.

I wish to acknowledge my indebtedness to professor Walter B. Cannon, of Boston, for valuable help and suggestions, and to Dr. L. B. Morrison, of Boston, for roentgen-ray data in some of the intestinal cases.

PRIMARY CARCINOMA OF THE VERMIFORM APPENDIX.

A REPORT OF 12 NEW CASES OCCURRING IN 10,651 SPECIMENS, WITH A SUMMARY INCLUDING 5 PREVIOUSLY REPORTED CASES AMONG 2500 SPECIMENS.

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Cases of primary carcinoma of the vermiform appendix to the number of almost 300 have been reported and a number of characteristics of this neoplasm has been revealed. It occurs more commonly in the female, occurs in younger rather than older persons; it has never been diagnosed clinically and seldom grossly; it is clinically usually benign, but malignant results have been reported; it is found in from 0.33 per cent. to 1 per cent. of appendices examined; it is almost always associated with some form of inflammation. It occurs in two main histological varieties, a form with small cells and usually much fibrosis, and a cylindrical-cell type resembling carcinomata of other parts of the intestinal tract.

In 1900, and again in 1908, Kelly[1] reported cases of primary carcinoma of the appendix from this laboratory, occurring among 2500 appendices examined. Since that time 12 more have been discovered in the routine examination of 10,651 more specimens as they came from the clinic of Dr. John B. Deaver. Short histories and abbreviations of the pathological reports and a summary of findings in the light of what has been revealed by the reported cases will be given. Mention of cases reported by Kelly will be included for the sake of completeness. In Case No. 4 of his first series doubt is expressed of the origin of the tumor, so it will not be included in this series. In 1 case the clinical history was lost, so that in the summary of clinical facts, 16 cases will be considered. To simplify classification the tumors will be grouped under two main types which, when reports are analyzed, can be recognized as the important ones, viz., the small-cell type and the columnar-cell type.

Case I (1898).—The clinical history was lost. Grossly the appendix showed gangrenous inflammation, with the distal two-thirds less involved but thicker than the proximal portion.

Histologically there was a high-grade ulcerative process present. A tumor about 6 mm. in diameter in the mucosa and submucosa was

[1] Kelly, A. O. J.: Tumors of the Vermiform Appendix, Proc. Path. Soc. of Philadelphia, 1900, new series, vol. iii. Primary Carcinoma and Endothelioma of the Vermiform Appendix, Am. Jour. Med. Sc., 1908, vol. cxxxv, 851.

found toward the distal end, and it consisted of nests of epithelial cells in a connective-tissue framework.

FIG. 1.—Photomicrograph of the small-cell type, showing nests and groups of small more or less rounded epithelial cells in the submucosa. The mucosa is completely ulcerated.

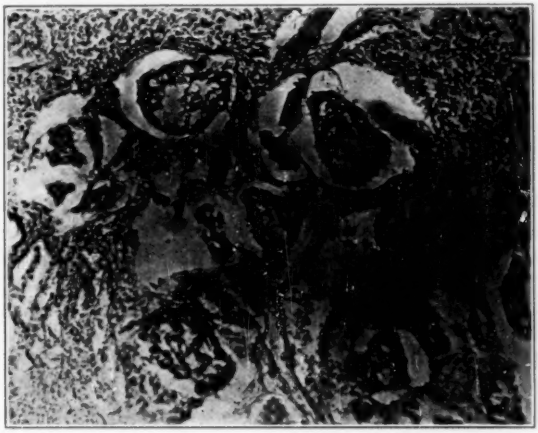

FIG. 2.—Photomicrograph of the columnar-cell type, showing groups of larger, more or less columnar cells in the submucosa, with a hint at "adeno" arrangement.

Diagnosis: Primary small-cell carcinoma of the appendix; acute ulcerative appendicitis.

CASE II (1899).—J. M., male, aged nineteen years.

He had pain eight days previous to admission. At operation a small encapsulated abscess at the appendix was found. Grossly a fibrinous exudate covered the appendix which, when pulled off, left the organ much distorted.

Histologically an ulcerative process was found and a small tumor in the submucosa toward the base, which was composed of nests of small epithelial cells in connective-tissue framework.

Diagnosis. Primary small-cell carcinoma of the appendix; acute ulcerative appendicitis.

CASE III (1906).—S. B., married woman, aged twenty-three years.

Operated by Dr. Deaver for acute appendicitis. The appendix was kinked on itself and curled about the cecum. A new growth invaded all the walls from the tip almost to the proximal end.

Histologically it consisted of nests of epithelial cells exhibiting mucoid degeneration. Evidences of chronic interstitial inflammation with acute exacerbation, were found.

Diagnosis: Primary small-cell carcinoma of the appendix; acute exacerbation of chronic interstitial appendicitis.

CASE IV (1907).—L. B., single woman, aged twenty-seven years.

Symptoms were referable to the upper right hypochondrium, and Dr. Deaver examined the gall-bladder region, where no abnormalities were found. The appendix was then removed through a separate incision. A bulbous enlargement was found at the distal end.

Histologically, nests of epithelial cells supported by well-developed connective-tissue stroma were found, which invaded the submucosa and muscularis. Chronic interstitial inflammatory changes with acute exacerbations were also found.

Diagnosis: Primary small-cell carcinoma of the appendix; acute exacerbation of chronic interstitial appendicitis.

CASE V (1908).—M. K., single woman, aged twenty-eight years.

Dr. Deaver operated for appendix abscess and found considerable pus and a perforated appendix. No evidence of new growth was found grossly, and even after it was discovered microscopically it could not be located by the unaided eye. It was annular and occupied the dilated peripheral extremity. Nests of epithelial cells in a well-developed connective-tissue stroma invaded submucosa and muscularis. Acute inflammatory changes of usual type were present.

Diagnosis: Primary small-cell carcinoma of the appendix; acute diffuse suppurative appendicitis.

The new cases are reported in more detail.

CASE VI (1908).—R. S., single woman, aged nineteen years.

Family and past histories were entirely negative. She has had recurrent attacks of pain in her right iliac fossa, lasting from a half

to twelve hours, since an acute attack which lasted three weeks, three months before admission. No vomiting.

Physical examination showed no abdominal tenderness at the time, but she pointed to McBurney's point as the seat of the pain. Temperature normal, white blood cells 12,800 with 81 per cent. polynuclears. Dr. Deaver operated, removing a swollen appendix. Uneventful recovery.

Appendix with a small portion of the mesentery 6 x 0.8 cm., bulbous enlargement 1.2 cm. in diameter at the tip. The serosa was covered with fibrinous exudate. Walls were edematous and the mucosa swollen. Section through the bulbous tip showed obviously a tumor of firm consistency invading from the mucosa outward to the serosa.

Histologically the serosa was covered by a fibrinopurulent exudate, showing beginning organization. All the coats were diffusely infiltrated by pus cells, vessels were intensely congested and there was considerable edema. Mucosa ulcerated, a few glands remaining showed mucoid degeneration. A new growth occupied the position of the submucosa and infiltrated the muscularis to a slight extent in only one portion of the circumference. It consisted of nests of more or less degenerated cells in well-defined groups of twenty to fifty embedded in a loose edematous connective-tissue framework. There was a hint at "adeno" arrangement. The individual cells were columnar, epithelial in character and showed marked cloudy swelling, with here and there pyknosis of nuclei and necrosis. The cytoplasm of the better preserved cells was abundant and stained well, and the nuclei were round and rich in chromatin.

Diagnosis: Primary columnar-cell carcinoma of the appendix; acute diffuse suppurative appendicitis.

Case VII (1909).—F. A., male, aged twenty-six years, married. Iron molder.

His father had had an arm amputated for cancer of the hand, and had died subsequently of "stomach trouble."

The patient had always been well with the exception of two attacks, eighteen and twelve months before, similar to the one which brought him to the hospital. The morning after a drinking bout he was seized with sudden, severe pain in the "pit of his stomach, which soon localized to his right iliac fossa, where it remained constant and severe and was not controlled by ice. Vomited several times. Temperature on admission was 99.4°; white blood cells numbered 11,300, with 66 per cent. polynuclears.

Physical examination showed a flat abdomen, rigid and tender in the right iliac fossa. No masses were discovered. Dr. Deaver removed a greatly inflamed appendix covered with exudate. Uneventful recovery.

Appendix 9 x 1 cm., with small portion of mesentery. The serosa was covered with fibrinous exudate, deeply congested. Walls thick-

ened and edematous, mucosa desquamated and partly gangrenous. Lumen patulous. Contents sanguinopurulent. About the distal third was a small area of thickening and induration almost annular.

Histologically the serosa was covered with a hemorrhagic fibrinopurulent exudate. A few pus cells and eosinophiles were scattered in the muscularis and submucosa. The mucosa was completely ulcerated. In the submucosa and invading the muscularis down to the serosa was a new growth consisting of small nests of cells embedded in dense cellular connective tissue in the submucosa and invading the muscularis in tissue spaces and between muscle bundles. The cells were small epithelial in type, well stained, with large round nuclei rich in chromatin.

Diagnosis: Primary small-cell carcinoma of the appendix; acute ulcerative appendicitis.

CASE VIII (1909).—M. R., married woman, aged thirty-two years.

Her family history was negative. She had had pneumonia at fourteen years and rheumatic fever at twenty-four. "Epigastric discomfort," "puffed feeling," occasional belching and heartburn were experienced for some time. Ten days before admission she was taken with sudden cramp-like pains in her right iliac fossa, accompanied by nausea and later by vomiting. They remained for seven days, when they subsided, but soon returned in the right pelvic region as well as around McBurney's point. Temperature, 99.6°; white blood cells, 10,900; polynuclears, 70 per cent.

Physical examination showed a rigid abdomen, with marked tenderness over McBurney's point. No masses were felt. Tenderness was also present in the right pelvic region.

Dr. Deaver found the appendix pointing toward the pelvis, constricted in the center, ballooned and tense at the tip, with marked serous exudation. Microscopically the serosa and the muscularis showed some edema. Occupying the position of the submucosa, mucosa, and obliterating the lumen was a tumor consisting of nests of epithelial cells, which invaded the muscularis to the serosa. The nests were embedded in loose, highly cellular connective tissue except in the muscularis, where they lay in tissue spaces and between muscle bundles. The cells were arranged more or less in gland-like form, with several rows around an attempt at a lumen; the individual cells were more or less cylindrical, with a fair amount of cytoplasm, lightly stained and highly granular. Nuclei were rounded and vesicular.

Diagnosis: Primary columnar-cell carcinoma of the appendix; acute serous appendicitis.

CASE IX (1911).—E. C., married woman, aged twenty-five years.

Family and past histories entirely negative. Two years before admission she noticed pain in the epigastrium, which at times became severe enough to "take her breath." It came about every two weeks, about two hours after meals, and lasted for about three

hours. Taking of food had no influence so far as she knew. She never was nauseated, never vomited nor belched. The pain never occurred in the right iliac fossa. Never jaundiced.

Physical examination showed no tenderness in the abdomen at the time. Pelvic examination revealed a small hard cervix, retrodisplaced uterus and tenderness on pressure along the neck of the uterus. Dr. Deaver removed an appendix, adherent and bound to the subcecal fossa. At the same time her cervix was dilated, the uterus brought forward and a small portion of the right ovary excised with a small cyst. Stones were removed from the gall-bladder and a cholecystostomy performed. Uneventful recovery.

Grossly the appendix showed a thickening which was obviously a new growth, hard and firm, occupying about half the circumference opposite the mesenteric attachment and extending almost the entire length of the organ.

Microscopically the serosa was normal. The musculature showed hyalinization and considerable lymphocytic infiltration. Replacing the mucosa and submucosa was a tumor consisting of strands and chains of cells of epithelial type which penetrated the muscularis to the serosa. The individual cells were small, rounded, with scanty light-staining protoplasm and round vesicular nuclei.

Diagnosis: Primary small-cell carcinoma of the appendix; chronic interstitial appendicitis.

Case X (1911).—E. L., seamstress, single, aged twenty years.

Family and past histories negative. Six months before admission she had acute, lower right abdominal pain, followed by vomiting and associated with tenderness, localized to the same region. She remained in bed for two weeks and afterward experienced pain of a drawing character in the appendix region until two weeks before admission, when acute pain returned, with vomiting. She again remained in bed, this time for four days, the tenderness persisting until admission.

Physical examination showed slight tenderness and voluntary rigidity over the right iliac fossa. Temperature, 99.4°; white blood cells, 6500; polynuclears, 58 per cent.

A thickened appendix was removed by Dr. Deaver.

Grossly the appendix gave no evidence of a new growth. The walls were slightly thickened, the coats obscured and the mucosa swollen.

Microscopically the serosa was thickened and the muscularis showed large areas of hyaline degeneration and considerable lymphocytic infiltration. Infiltrating the entire thickness over the whole circumference and up to the serosa was a tumor of large and small strands and chains of epithelial cells which penetrated in all directions. The cells were small, more or less circular, with small amounts of cytoplasm and relatively large dense nuclei. There were areas in the submucosa in several sections which were solid tumor masses.

Diagnosis: Primary small-cell carcinoma of the appendix; chronic interstitial appendicitis.

CASE XI (1912).—H. H., tailor, married, aged thirty-four years. Family and past histories were entirely negative. He entered the hospital to have a hernia of one and one-half years' duration repaired. Had no symptoms of any kind except the presence of the hernia.

Physical examination was negative except for a complete indirect right inguinal hernia.

Dr. Deaver removed a long, thick, stiff appendix and performed a herniorrhaphy. Uneventful recovery.

Appendix with small portion of mesentery, 9 x 0.8 cm. The serosa was slightly congested. The lumen was eccentrically placed, closer to the mesenteric attachment than to the opposite serosa. The thicker portion of the wall was 0.5 cm. thick, tough, firm and showed no differentiation of mucosa, submucosa and muscularis for a distance of 3 cm. in the middle portion. Distally and proximally the coats were distinguishable. Mucosa slightly swollen. Contents mucous.

Histologically the serosa was not thickened. Some evidence of chronic inflammation in a sparse scattering of lymphocytes in the submucosa and muscularis was seen. The mucosa showed a slight catarrh. A new growth invaded the submucosa and muscularis down to the serosa, consisting of small groups of cells thickly scattered in moderately dense connective tissue in the submucosa and invading the lymph channels, and between the muscle bundles in the muscularis. Cells are epithelial in type, rather small, polyhedral, fairly well stained and with densely stained nuclei.

Diagnosis: Primary small-cell carcinoma of the appendix; mild chronic interstitial appendicitis.

CASE XII (1913).—A. G., married woman, aged forty-five years. Family and past histories were negative. Was operated in 1911 and a large stone removed from the gall-bladder, which was drained and sutured to the parietal peritoneum. Four months after the operation, during which interval she was well, she commenced to have dull, dragging pain with soreness in the upper right quadrant about the site of the scar. A year after the operation nausea and vomiting after eating were added to her symptoms. She had much headache, languor, sleeplessness, and was obstinately constipated.

Physical examination showed an indurated and contracted scar, very tender. No pelvic or appendicular tenderness.

Dr. Deaver excised the scar and released many adhesions. The appendix, adherent to the cecum posteriorly and containing fecal concretions, was removed. Recovery.

The history before her first operation was as follows: Chief complaint: spells of pain in the upper right abdomen. For eight years she had been having several attacks a year of cramps in her

upper right abdominal region, which lasted about fifteen minutes and were not associated with any indigestion; but as the attacks grew more frequent and more severe, belching, heart-burn and flatulence occurred. She was never jaundiced and did not vomit.

Appendix with mesentery excised, 3 x 0.6 cm. Tip bulbous, with the lumen obliterated. Serosa slightly congested, wall thickened, mucosa swollen. Lumen narrowed to bulbous tip, where it was obliterated. Contents mucous. New growth not suspected grossly.

Histologically: Serosa was slightly thickened. Muscularis was atrophied and showed broad bands of hyaline degeneration. Mucosa absent. Obliteration of the lumen had taken place in the bulbous portion by hyalinized connective tissue, in which a small new growth was localized.

The tumor consisted of small nests of more or less degenerated, small epithelial cells, which stained poorly in both cystoplasm and nuclei and invaded the submucosa up to the muscularis but did not penetrate the latter coat.

Diagnosis: Primary small-cell carcinoma of the appendix; chronic obliterating appendicitis.

CASE XIII (1915).—Y. S., married woman, aged fifty-four years. Family and past histories indefinite. She had slight indigestion for about six months before admission, appearing shortly after eating. For three months previous to admission she had noticed she was growing yellow, and at the same time began having attacks of severe cramp-like pains in her upper right abdomen which radiated to her back and right shoulder and came at intervals of about two weeks and often required "medicine" for relief. Lost much weight.

Physical examination showed moderate jaundice and slight tenderness in the right hypochondrium.

Dr. Deaver found a large tense gall-bladder, which when opened yielded a large quantity of very dark bile and numerous small stones. The common duct was enlarged; it was opened, a probe passed into the duodenum and a T-tube was sewed in for drainage. The appendix was removed through the same incision. The pancreas was described as hard and nodular to the touch.

The T-tube drained well for about a week and the jaundice slowly disappeared, but the tube became clogged and was removed. Reddish-yellow, gritty material filled the tube. The wound drained bile and the jaundice had almost entirely cleared up when the wound closed and jaundice reappeared. This was repeated several times. Pains, chills and fever also accompanied the return of jaundice. Six months after the first operation, Dr. Deaver again opened the abdomen and explored the common and hepatic ducts. Sandy, cement-like material was obtained. Drainage was reëstablished but failed in a few days and the patient grew very deeply jaundiced and died in delirium. At a partial autopsy the hepatic and common ducts were found clogged with thick gritty material. Sections of the

pancreas and liver revealed advanced chronic interstitial pancreatitis and periportal cirrhosis of the liver, with acute and chronic cholangitis.

Appendix 8 x 0.3 cm. Small nodule at the tip. The lumen was entirely obliterated.

Histologically: Muscularis was atrophied and showed hyaline degeneration. Mucosa and submucosa were replaced by a tumor consisting of small groups of poorly defined and poorly stained epithelial cells embedded in connective tissue and invading up to but not into the muscularis.

Diagnosis: Primary small-cell carcinoma of the appendix; chronic obliterative appendicitis.

CASE XIV (1915).—F. S., unmarried woman, aged twenty-two years, clerk.

Family history and past history were both negative, except for an abscess of the rectum, which opened through the rectum six months before. She had had occasional pain in the right lower abdomen for about a year, but it was never severe enough to incapacitate her. Two weeks before admission she experienced severe pain, with vomiting, which lasted two days, and subsided only to reappear with greater severity. She vomited during both attacks and had a constant desire to urinate.

Physical examination showed moderate tenderness over McBurney's point.

Dr. Deaver removed an appendix 5 x 0.6 cm., in which the serosa was slightly congested, the walls somewhat thickened and the mucosa swollen. Mucofecal contents: No suspicion of tumor grossly.

Histologically: The serosa was normal. Quite large fat deposits were present between the muscularis and submucosa. Mucosa showed minor changes. Toward the circumference opposite the attachment of the mesentery was a new growth encapulated almost in its entirety by a thin connective-tissue layer apparently of the submucosa, which was richly sprinkled with lymphocytes. The tumor consisted of large groups of epithelial cells surrounded by a very fine network of connective tissue of younger type in alveolar fashion. The individual cells in the groups were entirely indistinct, the cytoplasm stained lightly, but the nuclei, large, round and vesicular, were quite prominent. Slight invasion of the submucosa was demonstrable in one small area, but the muscularis was free.

Diagnosis: Primary small-cell carcinoma of the appendix; chronic interstitial appendicitis.

CASE XV (1916).—T. K., married woman, aged thirty-five years.

Family and previous histories negative. She had constant pain and soreness in the right side of her abdomen for three years, worse in the right iliac fossa, but also present in her gall-bladder region. It was dull, constant, non-radiating, uninfluenced by food or menstruation, but worse some days than others.

Physical examination showed slight rigidity and tenderness over the gall-bladder region, more marked tenderness to the right and just below the umbilicus. Dr. Deaver removed the appendix for chronic inflammation.

The appendix was 6.5 x 0.7 cm. The serosa was slightly congested the walls somewhat thickened and the lumen obliterated. No macroscopic evidence of tumor.

Histologically: The serosa was normal. Muscularis well preserved. The mucosa was absent. The positions of the submucosa, mucosa and lumen were occupied by masses of epithelial cells embedded in dense cellular connective tissue. The cell masses were very numerous and close together. They stopped short at the muscularis and did not invade any point. Individual cells were small, rounded, with fairly well-stained, scant cytoplasm and large, round, dense nuclei.

Diagnosis: Primary small-cell carcinoma of the appendix; chronic obliterative appendicitis.

Case XVI (1917).—J. B., married woman, aged thirty-one years. Family and past histories were negative. Five children living and well. No miscarriage previous to the following: Two weeks before first admission she had a miscarriage, and bleeding continuing, she entered the hospital and a currettage was performed. Bleeding returned in a few days and continued for a month, when she again entered the hospital. During this time she had considerable "soreness" in the lower abdomen. Physical examination revealed slight tenderness over the lower abdomen. No masses. Cervix softened but not dilated; some tenderness to the right side of the uterus. There was a bloody discharge.

Dr. Deaver performed a hysterotomy and removed a small mass of tissue from the cavity of the uterus, which proved on microscopic examination to be decidual tissue. A small fecal concretion was felt in the appendix. Appendix, 7 x 0.6 cm., with the distal 1.5 cm. thickened to 1 cm. The serosa was normal, walls and mucosa slightly thickened. No gross suspicion of new growth.

Histologically: Serosa was slightly thickened; muscular coats were broad and well developed, richly sprinkled with lymphocytes and eosinophiles. Small areas of fat infiltration occurred here and there. There were no typical glands in the mucosa; replacing them were groups and nests of epithelial cells which invaded the submucosa and muscularis up to the serosa. The groups were composed of few rather than many epithelial cells in a fairly dense connective tissue in the submucosa, free in tissue spaces in the muscularis, and the cells were small, generally rounded, with scanty cytoplasm and heavily stained nuclei.

Diagnosis: Primary small-cell carcinoma of the appendix; chronic interstitial appendicitis.

CASE XVI (1915).—Of very special interest is the following case, which occurred in a girl, aged eight years, admitted to the Drexel Home with the diagnosis of acute appendicitis.

Four days before admission she was seized with general abdominal pain, which soon localized and remained in her right iliac fossa. Dr. Deaver removed a perforated appendix which was 7 x 1 cm. long. The serosa was congested and covered with fibrinous exudate; the walls were thickened and the mucosa swollen. Contents were mucopus. Proximally a small localized nodule was found histologically composed of nests of larger epithelial cells arranged "adeno" fashion. They infiltrated to the serosa but were localized to a small area. Pus cells, edema and active congestion were present in the walls.

Diagnosis: Primary cylindrical-cell carcinoma of the appendix. Acute diffuse suppurative appendicitis.

SUMMARY. *Frequency.* In 13,151 appendices examined grossly and histologically, primary carcinoma was found in 17 or about 0.13 per cent. The frequency in reported cases where both gross and histological examinations were made, varies from 0.3 to 1 per cent.

Sex. Reported cases show that about 65 per cent. occur in females. Of the 16 cases with histories in this series, 12 occurred in females, or 75 per cent.

Age. MacCarty and McGrath[2] report a case in a girl, aged five years, and Rogg[3] one in a man, aged eighty-one years. Most of the cases occurred in the second and third decades. The oldest in our group was aged fifty-four years and the youngest eight years. Most of the cases occurred between the ages of twenty and thirty years.

Prognosis. The immediate operative prognosis depends of course on the accompanying lesion, if any, *e. g.*, suppuration, perforation or the trouble for which laparotomy was performed when the appendix is removed incidentally. The great majority of cases reported shows that the condition is essentially benign; metastases and extension have, however, been reported, so that the malignant possibility is to be considered (Luce,[4] Ross[5]). The variety composed of columnar cells seems to be considered the malignant kind, but the data is inconclusive.

We have been able to follow three patients for periods of two years, one year and nine months respectively. All are well. The first patient had a tumor of the columnar-cell type (No. XVII). Kelly followed a patient for nine years and found he had been in poor health, having had sharp pains in his right iliac fossa and tenderness

[2] MacCarty, W. C., and McGrath, B. F.: Clinical and Pathological Significance of Obliteration, Carcinoma and Diverticula of the Appendix, Surg., Gyn. and Obst., 1911, xii, 211.

[3] Rogg, F. A.: Carcinoma und Carcinoid der Appendix, Ztschr. f. Krebsforch., 1913, xiii, 12.

[4] Luce, G.: Ueber sog. primare Carcinome und primare carcinome des Wurmfortsatzes, Beitr. z. klin. Chir., 1912, lxxxii, 155.

[5] Ross, G. G.: Carcinoma of the Appendix, Philadelphia Tr. Acad. Surg., 1912, xiv, 90.

in the incision at all times. This patient had a small-cell carcinoma (No. II in our series). No mention was made of extension or of enlarged lymph nodes in the operative notes in any of the cases.

Diagnosis. In none of our cases was the diagnosis made clinically, in agreement with the reported cases. The diagnosis of acute appendicitis was made in 8 cases, of chronic appendicitis in 4 and the appendix was removed incidental to laparotomy for some other trouble in 5 cases.

Types. The small-cell type occurred in 14 cases, or about 82 per cent., the columnar-cell type in 3 cases, in close agreement with the previously reported cases.

Gross Diagnosis. The tumor was diagnosed grossly in 4 cases. In 4 it could not be recognized grossly even when the histology was at hand.

Situation. Practically all of the tumors were situated at the tip or in the distal third. A bulbous tip was exhibited by four.

Concretions. Concretions were found in two.

Inflammation. Acute inflammation was present in 7 cases, chronic inflammation in 3, an acute exacerbation of a chronic process in 2, obliteration from fibrous tissue in 3 cases. The percentage of these is also in harmony with the previously reported case.

CONCLUSIONS. Three facts stand out very conspicuously in the study of the literature of this neoplasm. Our experience fortified these facts and the practical conclusions which have been drawn are substantiated. The condition has never been diagnosed clinically and a consideration of the symptoms which have been presented by the patients in whom the lesion has been found shows that nothing in any way suggestive of anything other than an ordinary acute or chronic appendicitis is presented. The second fact to be remembered is that the condition may give rise to extension and metastasis. The third consideration is that the condition may be present and yet not be evident on gross inspection either when the appendix is *in situ* or when it is in the pathological laboratory.

It follows therefore that aside from symptoms which lead to its removal it should be removed whenever the abdomen is opened in its neighborhood, regardless of symptoms, for in many cases discovered no symptoms at all were given. Every appendix should be subjected to both careful gross and histological examination.

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TWO CASES OF SUPRARENAL DISEASE.

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It is not purposed to describe suprarenal disturbances or to discuss the physiology of suprarenal secretion or to discuss the ordinary symptoms of Addison's disease. The following two clinical histories are unique, and for that reason they are presented.

Case I.—A man, aged thirty-four years, manager of a large factory; not married. He was first seen by me on September 7, 1915. So far as he knew he was well up to February, 1915, when he began to develop brown spots on his face and his whole skin began to darken. This pigmentation increased, spreading down to his neck, over his hands and somewhat over his body, so that at that date, namely, September 7, his face, neck, ears, hands and arms had become as black as the skin of an ordinary negro. The skin of the genitals and the surrounding region was absolutely black. He had a few jet-black pigmented spots on his thighs and some streaks on his back below the neck, with a little lighter (but still darker than normal) skin between these jet-black areas. The sides of his tongue were pigmented black; the top of the tongue was dark. The buccal mucous membrane and the lips were black. In January, 1915, he had weighed 163 pounds; his weight at the date of this examination was 140 pounds. He said he was at times very weak and could hardly move around. His hands and feet became cold and he had to cover himself very warmly at night. He complained of sweating a great deal. Pulse, 96; systolic blood-pressure, 95 mm.; diastolic pressure, 90. The heart sounds were normal but very weak; the lungs were normal; liver somewhat enlarged; right kidney movable and slightly loosened; spleen somewhat enlarged. The urine was normal. Wassermann test and blood examination both had been done in New York; the Wassermann test was reported negative and the blood reported normal.

The previous history showed that this man had never been really sick, except that he had had quinsy the year before. He passed an examination for insurance six years before. He stated that when he was a child his hair was blond, that it turned dark brown at seven or eight years of age, and at this time, September 7, 1915, it was jet black. He stated that his eyes were blue when he was young, then turned brown, and now at this date they were dark brown and the sclerotics were dark and pigmented. His digestion had been good, except that occasionally he had some flatulence; there was no pyrosis, nausea or vomiting. He had never raised any blood nor had a hemorrhage anywhere. He had never had a colic nor any jaundice,

with obstruction of bile passage, and, so far as he knew, he had never passed dark urine.

He had always been a hard smoker, smoking from twelve to fourteen cigars a day. He had never used much alcohol, but he was now taking five cups of coffee a day on account of the bracing effect.

His father died at fifty-nine years of diabetes; his mother died at fifty-eight of some heart trouble. Three brothers and three sisters were alive and well. Several brothers and sisters died very young.

I diagnosed suprarenal disease and gave him a 3-grain suprarenal tablet, three times a day, and a pituitary tablet, each representing 1 grain of the whole gland, twice a day, the latter with the idea of stimulating suprarenal activity.

I next saw this patient on September 14, one week later. The pigmentation had very much diminished from the trunk, leaving only a few darkened areas; the same was true of the mucous membrane of the mouth. The face was not as dark and the insides of his hands were almost normal in color. The amount of urine had been increased. The systolic blood-pressure was 100 and the diastolic 70. The pulse was 84 and very weak. His weight had increased to 138 pounds. His appetite, however, had become poor, and he had a great deal of indigestion, with pain in his upper abdomen, general, not localized anywhere. This pain came on more especially at night and was worse on lying down. He had never had this before. He also had some palpitation of the heart at these times. With this pain his face flushed. He also was having some pain along the spine.

I reduced the suprarenal tablets to two a day and the pituitary substance to one tablet a day.

This patient lived in New York, and the following week he wrote me that his face, hands and body had lost a great deal of the pigmentation, but that he was so weak he could not travel. I did not hear from him again until I learned that he had died on October 19, and an autopsy showed that both suprarenal glands were completely destroyed with tuberculosis and that there were large deposits of calcareous substance in them.

COMMENT. This case is unusual because of the marked symptoms of insufficiency of the adrenal glands, as shown by the unusual amount of pigmentation and the exceedingly low blood-pressure. There was no history of fever. The lungs and other parts of the body were not involved in the tuberculous process. There were no digestive symptoms until the last few weeks of his life. He died from the extreme weakness of his heart and the low blood-pressure. The pulse-pressure was one of the shortest that I have ever noted, the difference between the systolic and the diastolic being, at the first observation, only five points. Under suprarenal it temporarily increased to thirty points.

CASE II.—This patient is a married man, aged twenty-five years, and works in a weaving mill. He was first seen by me in consultation on June 28, 1917, with the history of having been well until May, 1917, when he began to vomit, associated with some cough. He had more or less continued fever, and an eruption of reddish spots on his skin, erythematous in type, this particularly on the feet, arms and elbows, on the flexor surfaces. He also had a great deal of pain in his feet and shoulders and burning sensations and paresthesias of all kinds and tinglings. These disturbances were sufficient to prevent sleep; these spots were not purpuric. There was no hemorrhage, although the gums bled slightly, and he had had several attacks of nose-bleed. His fever ranged about 100° and his pulse was about 100. He could eat practically nothing without vomiting; even water was vomited. He was too weak to stand on his feet. These erythematous and punctate spots disappeared, followed by a little desquamation in these regions, especially on the sides of the fingers and sides of the toes, but scarlet fever, although considered, was decided not to have been present. From this time, namely, about the latter part of May, the discoloration began to increase, and at this date, June 28, 1917, he was on many parts of the body as dark as a colored person, especially on his chest and abdomen, with a few white streaks mixed in with the dark pigmentation. His arms were dark; his face showed dark pigmented spots. At this time his cough had ceased and his vomiting was less frequent, but he was excessively weak and complained of numbness and tingling of his hands and feet from poor circulation. There were no edemas. The urine was negative. He had had very little pain in his abdomen except while vomiting.

This man had never previously been sick. He was married and had three children, the oldest five years of age and the youngest five months, all well. His father was well at seventy-three years; his mother died at sixty-nine years, cause unknown. Three brothers and four sisters were all well.

The heart and lungs were normal. Systolic blood-pressure was 100 and diastolic pressure 60. No history and no signs or symptoms or stigmata of syphilis. He had some pigmented spots in his mouth. The liver was slightly enlarged and the spleen palpable; the rest of the abdomen was negative. His usual weight was 138 pounds; at this date it was 110 pounds. He had a mass of enlarged glands on the left side of his neck, which had been increasing in size. Examination of the blood showed nothing specially abnormal.

A diagnosis of suprarenal disease, probably tuberculous, was made. He was given a suprarenal tablet, three times a day, and iron.

In two weeks the pigmentations began to disappear, and instead of being black on his abdomen and arms he was mottled. The glands of the side of his neck were smaller. There was no diarrhea; he could eat well and retain his food, but he felt very weak and

continued some afternoon temperature. Blood-pressure, 98 mm. systolic and 70 diastolic.

This man was then sent to the Gaylord Farm Tuberculosis Hospital for tuberculin tests. Roentgen-ray investigations of his chest showed no tuberculosis of the lungs; he reacted positively to tuberculin, but there were developed no focal reactions in the lungs. He remained at this hospital for four weeks, gained twenty pounds in weight and under suprarenal treatment the pigmentation almost entirely disappeared.

I saw him again on September 23, 1917, when the only pigmentation remaining was a small amount on the lower back and buttocks. He was running no temperature. The blood-pressure was 110 systolic and 80 diastolic. The tongue was clean; the liver and spleen seemed normal; the urine was negative; he was very weak and unsteady when he walked. The glands of the left side of the neck had broken down and now had formed an abscess. Have advised that his neck be treated surgically immediately. Suprarenal tablets were continued.

COMMENT. I have not seen or heard from this patient since this last date, September 23. I believe the prognosis to be bad in spite of the improvement. The amount of improvement is certainly unusual, especially as to gain in weight.

This case of adrenal disease is again one that is unusually marked by the pigmentation deposits and unusually interesting because of the disappearance of the pigmentation under suprarenal treatment. The loss of muscular strength in both these patients, due to suprarenal deficiency, was very marked. It cannot be entirely attributed to the low blood-pressure, and therefore poor circulation; it is in part, at least, due to muscle weakness.

MAGNESIUM SULPHATE SOLUTIONS IN THE TREATMENT OF SPASTIC CONTRACTURES OF THE RECTUM AND SIGMOID COLON.[1]

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ONE year ago, Meltzer in the symposium on Gall-stones before the American Gastro-Enterological Association, suggested the employment of a 25 per cent. solution of magnesium sulphate, given through the duodenal tube, in certain obstructions of the common duct, hoping thereby to produce a relaxation of the circular muscle

[1] Read before the American Gastro-enterological Association.

fibers of the ampulla of Vater. The experimental work of Meltzer[2] demonstrated that solutions of magnesium sulphate produced an inhibitory influence upon the peristaltic movements of the intestinal tract of animals whether the salt was given intravenously or applied directly to the mucosa. Briefly, his hypothesis is that the phenomena of peristalsis consists in a contraction of the proximal and relaxation of the distal part of a section of the intestine, following the law which he designates as "contrary innervation." The purgative action of magnesium sulphate when given by mouth results from the fact that a part of it acts by being converted into sodium sulphate and magnesium carbonate, substances which increase the irritability of the exciting or contractile phase of peristalsis, while the remaining unconverted magnesium sulphate acts by increasing the inhibitory or relaxing phase of peristalsis. From this hypothesis we may deduce that a condition of hypertonus in a section of the intestine is due to a disturbance of the law of contrary innervation, *i. e.*, a preponderance of stimulation occurs in the exciting or contractile phase.

For a long time I have been interested in the muscular contractures which occur in the lower colon and rectum as revealed by sigmoidoscopy. Furthermore, I am convinced that these contractures are pathological in character and that they are etiological factors in many cases of chronic constipation.

The deduction is therefore obvious that solutions of magnesium sulphate applied directly to a hypertonic or contracted segment of the bowel should have the effect of producing a relaxation. In a series of cases I have demonstrated that magnesium sulphate is really capable of overcoming such contractures and that this action may be utilized in the treatment of obstinate constipation.

In a review of 2000 cases of chronic constipation taken from my office files (dating from 1909) the following classification is tabulated.

960 cases of spastic constipation, the spasticities being located in the rectum, sigmoid and descending colon.

210 cases in which the entire colon appeared to be in a state of hypertonic contracture.

406 cases of chronic atonic constipation.

424 cases recorded as "indeterminate," meaning thereby that neither contractures nor atonic conditions could be ascribed as etiological factors.

Cases of partial intestinal obstruction due to organic conditions, such as strictures, growths, inflammatory processes, etc., are not included in the above series.

The proctosigmoidoscope is the most valuable diagnostic agent in the detection of hypertonic contractures.

[2] The Relation of the Purgative Action of Magnesium Sulphate to Peristalsis and the General Law of Crossed Innervation, Arch. Int. Med., June, 1915, No. 6, xv, 955.

No one experienced in its use will doubt the existence of the spastic form of constipation.

In cases in which the contracture is beyond the reach of the sigmoidoscope the diagnosis is made by the subjective symptoms, the characteristic fragmentary feces, combined with a strongly contracted palpably tender descending colon.

The *x*-ray diagnosis of contractures is extremely unreliable, chiefly because of the position and form of the sigmoid colon. The bismuth or barium enema will pass through an organic or spasmodic stenosis whose lumen is of very small caliber. It may canalize contracted areas which are concealed by the distended portion of the bowel and thus escape detection, especially as palpation is practically impossible in this region. Moreover, the bismuth or barium meal given by mouth is frequently scattered in a thin column along the lower colon giving an impression of contracture when no narrowing exists. Also the degree of tonus frequently changes in the normal colon and interpretation presents extreme difficulties. The illustrations show the difficulties encountered in attempting to make roentgenoscopic diagnoses of contractures.

FIG. 1.—A case of strong contracture at the rectosigmoid angle, but not visible in the plate.

Contractures of the rectum and sigmoid vary in intensity from mild contractures which readily yield to dilatation to strong spasms which form unyielding obstruction. The contractures may be located at any point in the rectum, sigmoid, colon, or descending colon including the splenic flexure. The most frequent site is

the rectosigmoid junction. Severe contractures at this point present a syndrome which I[3] have designated "sigmoidospasm."

FIG. 2.—The sigmoidoscope reveals strong contracture involving the first four inches of the sigmoid. The contracture is not visible in the plate.

FIG. 3.—This case is one of atony of the rectum and sigmoid. The atonic condition is well shown in the plate.

An obstinate form of constipation results from combined contractures and dilatations, *e. g.*, (*a*) atony of the rectum and sigmoid

[3] Soper, H. W.: Sigmoidoscopy, Internat. Clinics, 1916, iv, 260.

associated with contracture at descending colon; (*b*) contraction at rectosigmoid angle and atony of sigmoid loop; (*c*) contracture at splenic flexure and descending colon and atony of cecum.

FIG. 4.—Shows an apparent contracture. However, sigmoidoscopy revealed a perfectly normal condition.

FIG. 5.—Shows an apparent contracture. Yet sigmoidoscopy revealed perfectly normal condition.

ACTION OF MAGNESIUM SULPHATE APPLIED DIRECTLY TO CONTRACTURES. OBSERVATION MADE UPON 220 CASES. 1. A saturated solution was found to be most efficient.

2. The solution was applied by means of cotton applicators through the sigmoidoscopic tube (knee-chest position). A char-

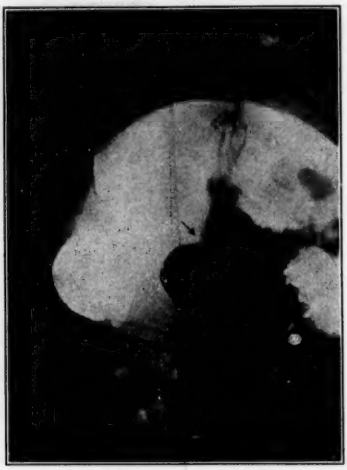

FIG. 6.—This is a case of strong, obstinate contracture at the rectosigmoid junction, possibly shown in the plate.

FIG. 7.—This is an obstinate case of constipation with spasticity of the entire colon and rectum.

acteristic diffuse, deep pink color of the mucosa is observed within from ten to twenty seconds.

3. Mild contractures disappear within a few seconds. Moderate contractures require a minute or two. Strong spasms require a series of applications to produce relaxation.

FIG. 8.—Shows a contracted and distorted sigmoid due to chronic adhesive perisigmoiditis. The picture is in accord with the sigmoidoscopic findings.

TREATMENT OF CONSTIPATION EXCLUSIVELY BY SATURATED SOLUTIONS OF MAGNESIUM SULPHATE. Eighty obstinate cases which had been under my care for a year or more. They had been under treatment by dietetic measures, enemata of oil, agar-agar, dilatations by means of oil applicators, insufflations of air, etc. None of them had been able to get along without the use of the oil enema. Sixty-eight cases have apparently been completely restored to a condition of normal colonic function. The number of treatments required in these cases varied from ten to thirty applications given every second or third day.

Five cases were complicated by inflammatory induration and distortion of the bowel at the rectosigmoid junction, consequently treatment was ineffectual.

In 7 cases the contractures were overcome but normal colonic function was not restored.

Seventy-two new cases of obstinate spastic constipation, *i. e.*, cases that were of long standing but that had not been previously under my care. Sixty-four cases were successfully treated with satisfactory restoration of bowel function. Eight cases were extremely neurotic individuals who could not stand the treatment although no real pain is produced by it.

Sixty-eight cases of obstinate spastic constipation, cases of long-standing constipation, but which presented contractures that were moderate in character, *i. e.*, that readily responded to treatment

and required but from six to ten applications to restore good colonic function.

The plan usually adopted is for the patient to return for treatment every second day, gradually lengthening the interval between treatments as the bowel function is restored. Purgatives and enemata of water must be avoided, inasmuch as they both increase the tendency to contraction. Oil enemata may be used in conjunction with the magnesium sulphate treatment when it is not convenient for the patient to come to the office for frequent treatments.

Cases in which the contracture is beyond the reach of the sigmoidoscope are treated by passing a soft-rubber catheter through the sigmoid tube and injecting 2 ounces of the magnesium sulphate solution, the patient retaining the knee-chest position for several minutes thereafter.

Sigmoidoscopic examinations of patients in whom normal function had been restored revealed the absence of previously demonstrated spastic obstructions.

While it is too early to assert that these patients are permanently cured, nevertheless some of the most obstinate cases have remained in a satisfactory condition for more than ten months.

THE ACTION OF ENEMATA OF MAGNESIUM SULPHATE IN THE RELIEF OF POSTOPERATIVE ABDOMINAL DISTENTIONS AND GAS PAINS. Observations of the condition presented by postoperative abdominal distention suggested the use of magnesium sulphate enema as means of relief. Roentgen-ray examination of 6 cases revealed that the colon alone was involved, no gas being found in the small intestine. The rectum and lower sigmoid were free from gas. Sigmoidoscopic examination showed the presence of marked contractures in the rectum and lower sigmoid. In a series of 30 cases I used an enema of saturated solution of magnesium sulphate given through the rectal tube. The technic is as follows:

Three ounces of saturated solution of magnesium sulphate is introduced by means of the rectal tube passed 4 or 5 inches into the bowel, elevating the hips whenever possible, and having it retained as long as possible. This procedure may be repeated every day, or several times a day if so desired.

The effect was quite remarkable. Large quantities of flatus were expelled, followed by immediate relief in 24 of the cases. The enema is usually retained for not more than five minutes. Occasionally it is retained for twenty-four hours; however, no harm results as no toxic effects have been noted.[4] Defecation often follows, not characteristic of a purgative dejection, but should the colon happen to contain much fecal matter, many passages may result. No rectal pain nor tenesmus follows the daily use of the

[4] Meltzer warns against giving too large a dose, as toxic effects have been observed particularly in animal experimentation.

enema. No evidence of increased peristalsis occurs. The magnesium sulphate solution evidently merely relaxes the contracted rectum and lower sigmoid and permits the retained gases and fecal matter to pass out of the distended colon.

The enema was also used in 2 cases of partial obstruction of the lower colon and sigmoid with very beneficial results. One such case was seen in consultation with Dr. H. G. Mudd. Patient, female, aged seventy-five years, presented the clinical picture of acute intestinal obstruction with great distention of the abdomen and much pain. Operative intervention was seriously considered. Patient had previously received large doses of cathartics, enemata of water, etc., without effect. The magnesium sulphate enema repeated from time to time was very effective. A later study of the case revealed that an adhesive periproctitis had resulted in a partial obstruction in the upper rectum. Evidently a muscular spasm was partly responsible for the stenosis which was overcome by the magnesium sulphate.

A second case was seen in consultation with Dr. John R. Caulk. The obstruction was located in the sigmoid loop, due to an extension of a pelvic abscess. Magnesium sulphate was again very effective, the patient making a good recovery. Within a week the operation of prostatectomy was successfully performed.

Realizing that personal enthusiasm is apt to impair one's judgment in forming an opinion as to the value of a therapeutic procedure, I asked several surgeons to try the enema in cases of postoperative gas pains and report their results to me. The replies representing 222 cases are summarized as follows:

Dr. Francis Reder: Magnesium sulphate inferior to alum enema combined with pituitrin.

Dr. W. H. Vogt: Magnesium sulphate inferior to intramuscular injection of pituitrin.

Dr. N. B. Carson: Used dilute solutions and results not satisfactory.

Dr. Mary H. McLean: Favorably impressed.

Dr. V. P. Blair: Favorably impressed.

Dr. Ernest Jonas: Favorably impressed.

Dr. G. D. Royston: Favorably impressed.

Dr. Willard Bartlett: Treatment of great value.

Dr. E. J. Neville: Treatment of great value.

Dr. O. H. Elbrecht: Treatment of great value.

Dr. John McH. Dean: Treatment of great value.

Dr. John R. Caulk: Treatment of great value.

Dr. H. G. Mudd: Treatment of great value.

Dr. P. Y. Tupper: Treatment of great value.

Dr. H. L. Nietert: Used it for years, and finds it of great value.

Dr. Major G. Seelig: Used it successfully for years in 50 per cent. solution combined with turpentine and green soap.

Dr. Tupper thus describes its effect: "Within a short time, ordinarily within one-half hour, there has been a free passage of flatus accompanied, not infrequently, with a fecal evacuation. Apparently the salt acts directly upon the rectum and lower sigmoid, causing relaxation of the muscular coat without producing peristalsis of either the large or the small intestine. Because of this the therapeutic measure is safe and especially serviceable soon after operations upon the intestine where evacuation of flatus is necessary for the patient's comfort and safety and where active peristalsis might produce serious results.

"Magnesium sulphate thus applied apparently is more effective than the enemata ordinarily used and is apparently free from the discomfort and danger accompanying their use."

I wish to express my thanks to Dr. R. Walter Mills for the roentgen-ray work and to Dr. D. L. Penney for valuable aid in the treatment of the cases.

CONCLUSIONS. 1. Spastic contractures of the lower colon are etiological factors in many cases of chronic constipation.

2. These contractures are the result of disturbances in Meltzer's law of contrary innervation.

3. A saturated solution of magnesium sulphate applied locally to the contracted segment produces a relaxation. Repeated applications finally overcome the spasticity and permit the restoration of normal colonic function.

4. Contractures in the rectum and lower sigmoid, with accompanying dilatation of the colon, are found in many cases of postoperative abdominal distention. Magnesium sulphate enemata are very efficacious in relaxing the contractures and thereby relieving the distention and "gas pains."

5. Enemata of magnesium sulphate are also very useful in partial organic obstructions in the rectum and lower colon, inasmuch as they relax accompanying muscular contractures without stimulating peristalsis.

6. Magnesium sulphate solution applied by means of the cotton applicator greatly facilitates the introduction of the sigmoidoscope.

SARCOMA OF THE HEART.

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INTRODUCTION. Of the various organs of the body the heart is the least frequent site of primary neoplastic change. Tumors of

the heart are therefore of pathological interest because of their rarity. They should excite a certain degree of clinical interest because there arises the question of the possibility of making a clinical diagnosis of cardiac tumor. As a matter of fact, tumor of the heart has never been diagnosed, *intra vitam*, as is apparent from a review of the literature of the subject.

Primary tumors of the heart are of less frequent occurrence than secondary tumors. The latter most often reach the heart by direct contiguity from tumors of the mediastinum and from tumors of the lungs, of the pleura, of the sternum, of the stomach, etc. They may also be carried to the heart from some distant organ, but this occurs infrequently. Metastases in the heart have been reported from malignant growths occurring in practically any part of the body, as cancer of the breast, of the stomach, penis, uterus, of melanotic sarcoma of the eye, etc. Tumors of the adrenals have been found to reach the heart by progressive sarcomatous thrombosis. Secondary tumors are more often carcinomas than sarcomas.

The first who called attention to the presence of a tumor of the heart, according to Tedeschi,[1] was Theophy Boneti, who found such a tumor, together with marked edema of the lungs, as reported in *Sepulchretum sivi anatomia practica ex cadaveribus morbo donatis*, Geneva, 1700, JIII, Miscellania, p. 505. Morgagni, in 1762, described numerous polypoid formations in the heart. (*De sedibus et causis morborum*, etc. Epist. XVI, Napoli, 1762.) We have no criterion as to the exact nature of the tumors described by these older writers. We do not know whether they were real blastomas or only blood-clots and organized thrombi, but we have to consider the possibility that they may have been real neoplasms.

The first authentic report of a primary cardiac tumor is that of Albers, who reported a primary cardiac "chondroid" in 1835, and later[27] corrected his diagnosis according to the progress which had been made in pathology, and called it a fibroma. The first sarcoma was reported by Bodenheimer in 1865. In looking over the literature one finds that more than 100 cases of primary tumors of the heart have been reported, but many of these must be rejected because they are not true tumors or are not primary in the heart.

Tedeschi,[1] reviewing the literature on this subject, counted up 86 cases, including 3 of his own. Unquestionably many of these cases are secondary tumors. Berthenson[2] found only 30 cases of unquestionable primary tumors, and his resumé dates from the same year. Among these 30 tumors were 7 sarcomas. Link[3] was able to collect 91 cases, but only 23 were of value from a clinical point of view. In his list are 13 sarcomas. Ehrenberg[4] collected 19 cases of sarcoma of the heart.

Among 2942 autopsies performed at the Johns Hopkins Hospital were found 10 heart tumors. These were all secondary except one rhabdomyoma. They were 1 sarcoma, 1 lymphosarcoma, 2 epithe-

liomas, 1 endothelioma, and 4 carcinomas (Bryant).[5] From 1903 to 1907 there were 6655 autopsies performed at the Pathological Institute of the University of Berlin. Among these were found 15 secondary carcinomas of the heart and 4 secondary sarcomas (Karrenstein).[6]

Many of the older writers report cancers of the heart. Indeed, it appears as if they called any malignant growth of the heart a cancer. These reports date back mostly to the premicroscopic days, and they are of little value to us from a pathological point of view. A carcinoma of the heart of a child of three days was reported by Billard in 1828, and Andrale and Boyle in 1824 reported a case of a carcinoma in the wall of the right ventricle (cited from Schöppler).[7]

However, primary carcinomas of the heart have been reported quite recently. Dietrich[8] reported a growth the size of the palm of a hand on the anterior and right mediastinal surface of the upper part of the pericardium in a woman, aged forty-four years, who died suddenly after having suffered for two months with dyspnea and anxiety without real heart difficulties. This tumor, a papillary carcinoma, did not infiltrate the myocardium, and the author considered it to be a primary carcinoma originating in the parietal pericardium, for no focus was found after careful search in any part of the body. Foerster and Garnieri[9] also reported a case of primary carcinoma of the pericardium (*Un caso de cancero endotheliale primitivo del pericardio*). It is difficult to understand how a primary epithelial tumor could originate in an organ which does not contain any epithelial tissue, unless the tumor has originated from the covering pericardial mesothelium.

The most common tumors of the heart are fibromas, myxomas, and fibromyxomas. Next in frequency are the sarcomas. Rhabdomyomas, lipomas, angiomas and lymphangiomas also have been reported. A teratoma has been reported by Joel.[10] This tumor was within the pericardial cavity attached to the pulmonary artery where it leaves the heart. Of special interest are the rhabdomyomas. They are a characteristic, well-defined group. Usually they are congenital, and in about 50 per cent. of the cases they are associated with a tuberous sclerosis of the brain.

Of late years the fibromas and the fibromyxomas have attracted special attention. According to several investigators, as Thorel, Stahr and others, many of this class of tumors reported as primary are not genuine blastomas but pseudotumors, namely, organized thrombi which have undergone a certain metamorphosis by edematous changes and formation of elastic fibers. Méroz,[11] in 1911, reported 3 primary heart tumors which were found among 3000 autopsies. Two of these he diagnosed as fibro-élastomes hemorrhagiques and the third one as a sarcoma. The first 2 are considered by Thorel as organized thrombi. There is no question but that many of these tumors are nothing but organization tissue.

The origin of these neoplasms may be in any of the layers of the heart wall, in the endocardium, the myocardium or the epicardium. Some of the tumors reported had their origin in the parietal pericardium, but the majority originated in the endocardium. Link,[3] in his report of 91 cases of primary tumor, pays special attention to the site of the tumor. He finds that 24 among this number were located in the left auricle, 10 in the right auricle, 14 in the right ventricle and 8 in the left ventricle. Sixteen were valve tumors; 3 were situated in both auricles; 2 in both ventricles; 2 in the right auricle and ventricle; 2 in the left auricle and ventricle; 2 only in the auricular septum.

According to the type of cell of which they are composed, sarcomas of the heart are classified as round-, spindle-, mixed- and giant-cell sarcomas, and with regard to their structure they may be plain sarcomas, myxosarcomas, fibrosarcomas and angiosarcomas. An osteosarcoma and a sarcoma lymphangiecticum have been reported in dogs.

The etiology is of course unknown. Ribbert thinks they may be due to superfluous cell material in the auricular septum due to disturbances in development. The reason for the rare occurrence of cardiac tumors is, according to Adami,[12] that "The heart above all organs is constantly in a state of great efficiency, well nourished, well innervated and functionally always active, so that it is less likely to take on aberrant growth."

Symptoms, Clinical Course and Diagnosis. That a clinical diagnosis of tumor of the heart has never been made can be explained by the fact that this pathological condition does not produce a characteristic picture. The diagnosis, which appears to me the most rational, was the one made by Biermer, who diagnosed the case reported by Bodenheimer[13] as "cardiac disease of unknown origin."

From a clinical point of view we may divide tumors of the heart into two groups: (1) those which produce symptoms, and (2) those which do not produce symptoms.

Frequently these patients do not present any, or very few, symptoms suggesting cardiac trouble. Some die suddenly and without having shown any signs of the disease, and the cardiac tumor is then found on the autopsy table as a surprise. In some cases the symptoms appear suddenly and death occurs in a short time. The reason for this may be that a malignant growth of the heart may remain stationary for a long time, the same as an ulcus rodens or a carcinoma of the stomach, and then flare up suddenly and produce severe symptoms and death in a short while, as in the author's case.

The symptoms which are produced by a cardiac tumor depend upon its location and upon its size. We may easily understand that a small tumor located on the surface of the heart, not interfering with the circulation, may not produce any symptoms whatsoever. However, a tumor, even if of a very small size, located on or near

a valve, is liable to produce a stenosis of a cardiac orifice or prevent proper closure of the valve, so that soon symptoms of disturbed circulation may arise. When a tumor is large its mere size is apt to produce these symptoms by encroaching upon the cavities of the heart or by pressure upon the large veins. It is evident that these symptoms are produced mechanically. How sudden death may thus be produced is demonstrated by Fuhrman's case. In this case the ostium of the right coronary artery was occluded by a sarcomatous growth, and a sarcomatous embolus was found at the opening of the left coronary artery. In the cases of secondary cardiac tumor, when a focus exists in some part of the body, a metastasis into the heart may sometimes be inferred, when suddenly heart symptoms develop in a previously well-working heart, but even here no certain diagnosis can be made.

As to the diagnosis of cardiac tumors, Hoover[14] states that "it is either impossible or a matter of good fortune." When symptoms are present they are those of heart disease, and the clinician then thinks properly of the more common morbid conditions, "for unless we wish to indulge in the merest guesswork we must hold fast to the principle that in an individual case the probabilities are more in favor of ordinary clinical conditions than of the rarer anomalies."[15]

Several writers have tried to find symptoms which are diagnostic of cardiac tumors, but they did not succeed. Bodenheimer[13] states that "one can think of heart tumor when history, clinical examinations and observation do not speak for any other heart disease, when the symptoms occur rather suddenly and unexpectedly and the condition *soon* takes a faster, *soon* a slower course."

Krehl[15] states that it is suggestive of heart tumor when a marked congestion occurs along the course of one vein, while other parts, which also ought to be affected in the course of ordinary cardiac disease, escape altogether. Fraenkel[16] considers the frequent recurrence of hemorrhagic pericardial effusion, necessitating frequent paracenteses, as a diagnostic symptom of cardiac tumor, and Eichhorst[17] states: "It must be said that tumors of the heart hide themselves sometimes behind the picture of pericarditis." The most important diagnostic means used today are the roentgen-ray picture and the fluoroscope. Only in 2 of the cases reported below (Ehrenberg and Sternberg) were these means used, for most of the cases were reported before we had these means of diagnosis.

Report of Case. The rare occurrence of primary sarcoma of the heart induces me to report the following case of sarcoma which originated in the subepicardial areolar tissue. It is of interest because of its large size, its well-defined structure and on account of the hemothorax which was associated with it.

The patient, a business man, aged forty-three years, entered the Michael Reese Hospital, December 4, 1916, as a private patient

of Dr. H. Schiller.* He complained of shortness of breath and cough. He first noticed two weeks previously that he became short of breath easily. He also had a slight irritation in the left side and thought that that caused the cough. After the dyspnea and cough had persisted for one week he consulted a physician, who told him that he had a slight bronchitis, and gave him some cough medicine. When, one week later, he had found no relief he went to Dr. Schiller, who found flatness over the left base and other signs of fluid. By thoracentesis he withdrew bloody fluid and sent the patient to the Michael Reese Hospital. The patient has not had any pain to amount to anything during the course of the disease.

Following is an extract from the hospital records:

Past History. He had pneumonia four years ago. He also had several attacks of influenza with pleurisy.

Family History. Negative. There is no tuberculosis or carcinoma in the family.

Physical Examination. A well-developed, middle-aged man who complains of pain in the left side and of difficult breathing. The head and neck do not show anything abnormal. The pupils are equal and react to light and distance. Chest: There is dulness to flatness over the entire left thoracic cavity, extending almost to the clavicle. No breath sounds are heard here. The heart is pushed to the right for two and a half inches. The heart sounds are normal; no murmurs are heard. The abdomen is distended but not tender. The extremities are negative.

On the first day of his residence in the hospital a thoracentesis was done. One quart of bloody fluid was removed. No organisms were found in this fluid, neither by direct smear nor by cultures on blood agar, bouillon and common agar slants. Ziehl-Neelsen stain for tuberculosis was negative. The cellular elements present were fresh red blood cells, lymphocytes, pus cells and endothelial cells, the red blood corpuscles predominating. 1300 leukocytes were counted per cubic millimeter. Many shadows of hemolized red blood cells were seen. The repeated examinations of specimens of fluid revealed no new information. Altogether ten specimens of bloody fluid were obtained from the left thoracic cavity:

December 4	1000 c.c.
" 6	1000 c.c.
" 7	1800 c.c.
" 10	1900 c.c.
" 13	2700 c.c.
" 15	2400 c.c.
" 16	1900 c.c.
" 17	1300 c.c.
" 18	900 c.c.
" 19	450 c.c.
Total	15,350 c.c.

*I wish to express my thanks to Dr. Schiller for his permission to publish this case.

Since the pleural cavity filled up so fast after each thoracentesis a thin catheter was introduced and left there for drainage after several thoracenteses had been done. Several times air was injected into the pleural cavity after 500 to 1000 c.c. of fluid had been withdrawn.

An intravenous infusion of 60 c.c. of blood was performed on December 15 and of 50 c.c. on December 16.

Examinations of the sputum for tubercle bacilli were made December 6, 11 and 12. The usual organisms were present and no tubercle bacilli were found.

The Wassermann test was made on the blood December 4, 11 and 15, and found negative each time.

A guinea-pig was injected intraperitoneally with the pleural fluid on December 7. It did not develop tuberculosis.

The patient's temperature on admission was 100° F. and never went over 102.4° The pulse was always over 100. Usually it was between 108 and 120; the highest rate recorded was 130.

In the urine several times a trace of albumin was found and a few epithelial cells or leukocytes.

It is interesting to follow the blood changes with the continual loss of blood:

	Red blood count.	Hemoglobin, per cent.	White count.
December 4	5,080,000	90	21,800
" 6	5,696,000	85	20,000
" 7	5,696,000	..	22,200
" 8	....	..	28,600
" 10	4,867,000	75	27,800
" 12	4,013,000	70	26,000
" 14	3,167,000	50	48,400
" 15	2,987,000	50	112,000
" 16	....	..	134,000
" 17	2,203,000	45	122,000

	Differential count.*								
	N.	S. M.	L. M.	T.	E.	B.	N.	Stain.	Cells counted.
December 4	82	12	6	0	0	0	0	Wright	100
" 8	86	9	5	0	0	0	0	"	100
" 17	89	4	7	0	0	0	0	"	100

The coagulation time on December 9 was 3.5 minutes and on December 10, 3 minutes.

The blood-pressure on December 6 was 115, 90 and 25 mm., and on December 7, 110, 85 and 25 mm.

The pulse was intermittent, weak and irregular; respiration was at times irregular, usually over twenty and sometimes as high as forty per minute. The outstanding symptoms were shortness of breath, profuse perspiration, restlessness, vomiting, nausea, dizziness, feeling of faintness, weakness, thirst and coughing. He died December 21, 1916, at 12.05 A.M.

All these symptoms can be explained by an excessive loss of

* N. = Neutrophiles
S. M. = Small Mononuclear
L. M. = Large Mononuclear
T. = Transitional cell
E. = Eosinophile
B. = Basophile
N. = Nomoblast

blood, which is the outstanding and most remarkable feature of this clinical picture. Altogether 15,350 c.c. of bloody fluid were obtained from December 4 to December 19. A definite diagnosis as to the reason for the continued bloody exudate in the pleural cavity was not made. Since the common symptoms of heart disease, as murmurs, edema, ascites, etc., were not present, tumor of the mediastinum and tuberculosis mainly were thought of. No tubercle bacilli were found in repeated examinations of the sputum and the pleural fluid, and tumor of the mediastinum was left as the probable diagnosis.

REPORT OF AUTOPSY. The postmortem examination was performed ten hours after death. The anatomical diagnosis was as follows: Subepicardial sarcoma of heart (mixed cell). Metastases into pericardial fat, pleura and mediastinal lymph glands. Chronic obliterative pericarditis. Left hemothorax. Patent foramen ovale. Arteriosclerosis of ascending aorta. Adipositas cordis. Atelectasis of left lung. Chronic fibrous pleurisy of right lung. Passive congestion of upper lobes of right lung. Lobar pneumonia of right lower lobe. Anthracosis. Acute and subacute interstitial pneumonia. Chronic emphysema. Acute splenitis. Acute inflammation of adrenal glands. Cloudy swelling of liver, pancreas and kidney.

The body is opened by the usual longitudinal incision. A thick layer of yellow subcutaneous fat is present.

Chest. On opening the thoracic cavity the right lung is found adherent to the chest wall by a moderate number of old dense adhesions. The left pleural cavity contains about one liter of bloody fluid. The left lung is very small, occupying the lower and posterior part of the left pleural cavity. The heart and the space between the lungs are covered with an unusually large amount of fat. The parietal and visceral pleura on the left side are thickened and covered with a soft, jelly-like, mushy or stringy, grayish exudate which is covered with blood, giving the parietal wall, especially on its left lateral and posterior aspect, a ragged appearance. The left lung is adherent to the chest wall by this material, but is easily loosened.

The left pleura presents on its visceral surface many grayish-white, irregular areas of different size, measuring up to 7 cm. in diameter. They are not raised from the surface of the pleura. On cross-section they are not seen to invade the lung tissue. They are 1 to 2 mm. thick.

Lungs. The small left lung is entirely submerged in bloody fluid and is not seen when the chest is opened. It weighs 287 grams. Adhesions of the character described above are present between the lower lobe and the diaphragm, between the lung and the mediastinum, and between the lung and the chest wall. Its color is red like that of muscle, on the surface as well as on cross-section. It is firm to touch, crepitus is absent and pieces excised sink in water.

The right lung weighs 555 grams. Isolated, old, dense adhesions

are present between the lung and the parietal wall. The adhesions are marked between the right lower lobe and the diaphragm; in loosening them the lung tissue is torn. Under the pleura many blackish areas of different size are seen (anthracosis). On section the upper lobe is crepitant, but is dark red and congested. Excised pieces float on water. From the cut surfaces a bloody, frothy fluid escapes. The lower lobe is of increased firmness; crepitus is present, but greatly diminished. On cross-section it is dark red in color and a bloody fluid, with some air bubbles in it, escapes on pressure. Excised pieces sink in water. No tumor metastases are seen or felt in the lung tissue.

Heart. The heart is hidden in an unusually large mass of lobulated, yellow fat, which is somewhat firmer than usual. The amount is so large that on first inspection the heart is not seen at all. The pericardial sac is completely obliterated, the parietal and visceral layers of the pericardium being firmly adherent to each other. On the left border of the heart a tumor is present. On account of the large amount of fat around the heart its borders and size cannot be made out. The tumor tissue is cystic in the incised area. A slightly cloudy fluid escapes from the incised cysts. One area in the center is broken down and a bloody and pus-like fluid escapes from it. The heart, with its vessels entering and leaving at the base, the right lung, the trachea and its bifurcating bronchi are removed *in toto* and dissected after having been hardened in formalin. From the hardened specimen the fat is removed and the tumor is found occupying the right border and the larger part of the posterior and the diaphragmatic surface of the heart. The lower border of the tumor is 5 cm. from the apex. The superior pole reaches up to the pulmonary artery, which arches over it (Fig. 1, *c*). The entire tumor in its largest diameters is 13 cm. long, 8 cm. wide and 5 cm. thick. The ascending aorta is anterior and to the right of its upper part. The left auricle is to the right of it and both ventricles are anterior to the lower part of the tumor. The lower surface which rests against the diaphragm measures 6 by 6 cm. This surface presents a ragged appearance after having been loosened from the diaphragm, due to the adhesions which have been broken up here.

The tumor consists of two portions (Fig. 1, *d*), a lower which forms part of a sphere and an upper one which is cone-shaped. Between these two portions is a constriction (Fig. 1, *e*). The lower part is the larger and projects from the surface of the heart, on which it rests by a large base.

On incising the tumor it is found to be sharply outlined. It is covered with pericardium. The latter is moderately thickened and its external surface is roughened. It is seen to consist of two layers which in most places can be easily separated. The tumor can be shelled out from this membrane like an orange from its peeling. (Fig. 1, *g*). In some places, especially in the inferior part of the tumor, the pericardial membrane is more firmly adherent to it.

The surface of the tumor, exposed under the pericardium, is smooth and of a white color. The line of demarcation of the tumor and the myocardium is also well defined, and the tumor tissue is differentiated from the myocardium by its color, consistency and general appearance. The color on cross-section is grayish-white. In some places it is soft in consistency and fat-like to touch in the fresh specimen; in other areas it is firmer. The cystic portion feels cartilage-like in the hardened specimen. These cystic cavities, which are present only in the lower part of the tumor (Fig. 2), are of

FIG. 1.—Photograph of posterior aspect of heart. *A*, trachea; *B*, bronchus; *C*, probe in pulmonary artery; *D*, the two lobes of the tumor with a constriction at *E*; the tumor is incised and the two halves pried apart by two pieces of wood; *F*, wall of left ventricle; *G*, the two layers of the pericardium peeled off from the tumor and reflected.

variable size and shape and measure up to 1 cm. in diameter. In the center of the lower as well as in the upper portion are brownish-red areas of degeneration. They are most marked in the lower part, where one cavity is present, about 2 cm. in diameter, containing bloody, purulent fluid. The upper portion produces a bulging into the wall of the aorta, but leaves enough free space here to allow the circulation of the blood. No metastases are seen in the veins at the base of the heart. The myocardium is normal in color and general appearance. The wall of the left ventricle is 12 mm. thick. It is nowhere seen to be invaded by the tumor tissue.

The endocardium is smooth and glistening. No tumor masses are present on it. The valves are smooth and competent. Only the aortic valve presents a slight thickening at the bases of the cusps. Some yellowish, hardened patches are also seen in the ascending aorta.

The foramen ovale is closed except for a slit-like opening at the upper border of the fossa ovalis, but the layers of the endocardium are overlapping here, preventing the blood from flowing from the right auricle into the left.

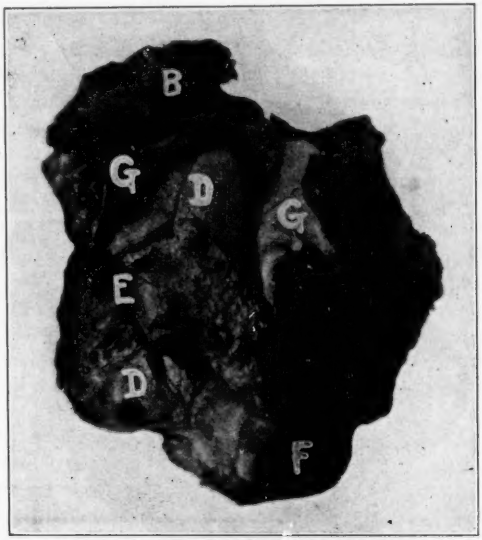

FIG. 2.—Shows the cystic degeneration of the lower part of the tumor which is laid open. *B*, bronchus; *D*, the lobes of the tumor, with a constriction at *E*; *F*, wall of left ventricle; *G*, the two layers of the pericardium peeled off from the tumor and reflected. This figure shows the cystic degeneration in the lower portion of the tumor.

The glands at the roots of the lung and in the mediastinum are not increased in size or number. The largest glands are about the size of a bean, and on macroscopic examination they were not considered to contain metastases.

The examination of the abdomen did not show anything of special interest. A large amount of fat was present on the large intestine, in the mesentery and retroperitoneally. There was no fluid in the abdomen. The abdominal organs appeared anemic. The liver tissue was of a yellowish color, suggesting fatty changes. It weighed 2170 grams. The spleen weighed 100 grams and appeared somewhat firmer than usual. The kidneys were pale and cloudy and weighed 200 and 190 grams respectively. The intestines were very anemic; pancreas, bladder, adrenals and prostate appeared normal. A

thorough examination for a focus of tumor tissue in any other part of the body was made and no focus was found.

Microscopic Report. Heart. Sections from different parts of the tumor were examined. One section shows the relation of the myocardium and pericardium to the tumor. It is taken from a place where myocardium, pericardium and tumor tissue meet. A large portion of this section consists of myocardial muscle, which is cloudy and infiltrated by lymphocytes and pus cells. Some of the nuclei of the myocardial muscle are rather large and deeply stained.

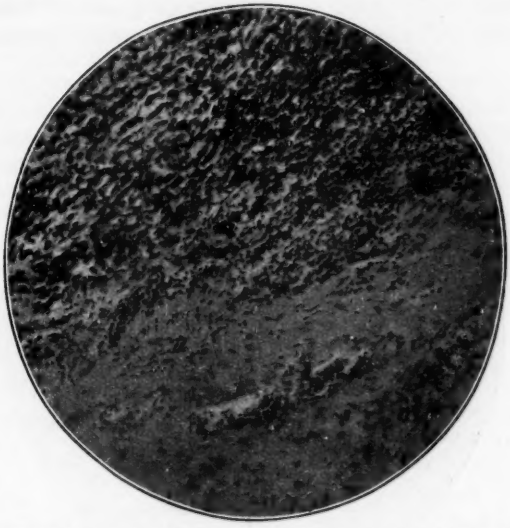

FIG. 3.—Photomicrograph of a section which is taken from the border of the tumor and includes a portion of the pericardium. There is a marked infiltration of small round cells, especially in the pericardium. Mayer's hemalum and eosin. Magnification, 140.

Next to the heart muscle is a layer of subepicardial fat, infiltrated by pus cells and lymphocytes. Peripheral to this is a zone consisting of fibrous tissue. In part of the section this layer is deflected. Here, next to the subepicardial fat, is tumor tissue, and the layer of fibrous epicardium and pericardium runs along the outer border of the tumor, so that the latter is bordered by pericardium on the one side and subepicardial fat on the other. Pericardial fat is peripheral to the pericardium, and it is richly infiltrated with tumor cells.

The pericardial tissue covering the myocardium and the tumor is diffusely infiltrated with large numbers of lymphocytes and a moderate number of pus cells. It contains many young small bloodvessels and cellular strands, consisting of spindle cells and lymphocytes. The connective tissue next to the tumor is hyaline-like and contains few nuclei (Fig. 3). In one area there is a small

number of tumor cells in the pericardial connective tissue. Between the tumor and the pericardial connective tissue are large masses of lymphocytes. The tumor is made up of closely packed cells which are mostly oval, round or spindle shaped (Fig. 4). Their size varies, but most of them are rather large. Their nuclei are prominent, rich in chromatin and stained deeply blue. Abnormal mitotic figures are present. Most of the spindle-shaped nuclei have fibrillar protoplasm on both poles; around the round cells little or none is seen. The connective tissue is small in amount and the blood supply is poor. Large areas of the tumor tissue are necrotic. These areas are stained well with eosin, have a homogeneous appearance and

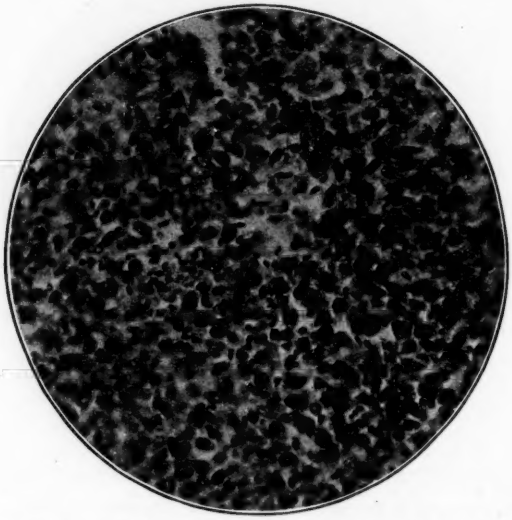

FIG. 4.—Photomicrograph of a section of the tumor showing the type of cells and the structure. Mayer's hemalum and eosin. Magnification, 285.

contain much pyknotic nuclear material. The tumor tissue in this section and all the other sections examined is richly infiltrated with pus cells and lymphocytes.

A section taken from the cystic area presents mostly necrotic tumor tissue. The cyst wall consists of necrotic tissue without nuclei. The cavity contains chiefly pus cells and red blood corpuscles. Large areas of pyknosis are present, and other areas, which are stained deeply with eosin, contain no nuclei.

In a section from that part of the tumor which rests against the diaphragm four zones are present. The first zone consists of tumor tissue, which is largely necrotic. The pericardial layer next to this divides and encloses a large area of tumor tissue, which appears to

be in the obliterated pericardial cavity. Peripheral to this is the pericardial adipose connective tissue, richly infiltrated with tumor cells, and outside of this is necrotic sarcomatous tissue. The irregular torn adhesions of the diaphragmatic surface of the tumor are made up of sarcomatous tissue according to this section.

Myocardium. The surface of this section consists of a dense connective tissue, which is infiltrated by numerous lymphocytes and pus cells. In some regions two layers can be recognized, separated by fibrin and inflammatory exudate. These two layers correspond to the parietal and visceral epicardium and are fused together by inflammatory tissue. Beneath this layer is the subepicardial fat. The myocardial muscle contains moderate numbers of lymphocytes and leukocytes, especially in the bloodvessels. The cardiac muscle cells are cloudy. In one area this condition is pronounced, the muscle appears opaque and homogeneous and in some fibers the nuclei appear to be lost. No metastases were found in the myocardium in this section nor in any of the other sections which were examined.

Lung. Numerous leukocytes and lymphocytes are scattered throughout the sections. They are contained chiefly in the connective tissue of the alveolar septa and in the small bloodvessels. The alveoli contain air; some are distended and the septa between the alveoli are thinned or broken in places. Some of the air sacs contain serum with desquamated epithelial cells and a few leukocytes and lymphocytes.

In a section from the left lung taken from one of the grayish areas described in the gross examination the lung is covered by a thick layer of sarcomatous tissue. Peripheral to this is a thin layer of connective tissue, infiltrated with lymphocytes and containing numerous spindle nuclei and some leukocytes. The tumor cells are large and prominent, rich in chromatin, and appear to be younger than in the original tumor. No areas of degeneration are present.

The boundary of the tumor tissue is well-defined. Beneath it is inflammatory tissue which contains many young bloodvessels and young connective-tissue cells, and is infiltrated by numerous lymphocytes and leukocytes. So also is the underlying lung tissue. The alveoli are compressed. Few or no air spaces are present in some areas, the lung tissue being solid and compact and infiltrated by pus cells and lymphocytes. In other areas the air sacs are distended and the septa broken through. In none of the sections examined are any tumor cells found in the lung tissue.

A section made from the mushy soft material between the lung and the parietal wall shows this tissue to consist of the same elements as the original tumor.

Mediastinal Lymph Nodes. Sections from two lymph nodes were taken. Both consist chiefly of sarcomatous tissue, which has replaced the lymphoid tissue. Only in a few places near the capsule

a small rim of lymphoid tissue is left. In one node the center is degenerating.

A section taken from the diaphragm includes the soft sarcomatous material between it and the heart. The diaphragm is not invaded with tumor cells.

Liver. The parenchymatous cells are cloudy and indistinct. They contain many fat globules of large size, and large areas of liver tissue are replaced by fat cells. Many pus cells are present, but they are chiefly contained in the sinusoids and vessels.

Spleen. The spleen is diffusely infiltrated with pus cells.

Pancreas. The bloodvessels contain many leukocytes. The parenchymatous tissue is cloudy.

Adrenals. The adrenal cells show degenerative changes. The medulla is richly infiltrated with lymphocytes and moderately with pus cells. The pus cells are numerous and in the bloodvessels. The large numbers of leukocytes found in the bloodvessels in the different organs is explained by the high white count, which three days before death was 122,000.

The microscopic examination proves that we have a sarcoma of the the mixed cell variety. The tumor is entirely pericardial. The myocardium is nowhere involved in the sections examined, which were taken from different places in the heart muscle. Microscopic examination as well as gross inspection shows that the tumor is covered by a membrane consisting of two layers, the visceral and parietal pericardium. The tumor is peripheral to the subepicardial fat, and it is probable that it originated in the subepicardial adipose tissue.

In two sections the pericardium covering the tumor contains sarcoma cells, but on its external surface a thin layer of sarcomatous tissue is present, making this surface irregular.

It is evident that the original tumor is the big tumor on the surface of the heart, and the tumor tissue found in the pericardium, pericardial fat, the pleura and in the mediastinal glands are metastases for the following reasons:

1. On account of the large size of the cardiac tumor and its well-defined structure.

2. It is the oldest of the sarcomatous tissue examined, as shown by the cystic, necrotic areas which are seen on microscopic and macroscopic examination.

3. The cells of the sarcomatous tissue in the pleura and lymph glands are younger in appearance, more active and do not present such marked degenerative changes.

Discussion. It is a rather difficult undertaking to give a review of the literature of sarcoma of the heart, for some of the cases reported are obviously not sarcomas, and with others there is no proof that they are primary. Among the latter I count the case of G. Impacciante[18] and of Williams and Miller.[19] Both are

cases of sarcoma of the mediastinum. In the latter case a tumor was found filling up nearly the entire chest cavity, adhering to the anterior surface of the heart, to the sternum and the diaphragm. In such a large general sarcoma of the mediastinum it is difficult to determine its origin. Other cases which are questionable as to their origin have been reported as primary sarcomas of the heart.

Some writers classify as sarcomas cases which are not reported as such, as the case of Zanders,[20] who reported a fibroma of the heart and remarked that in some places the cells were spindle-shaped, the structure approaching that of a spindle-cell sarcoma. Similarly, Crawfurd[21] reported a tumor of the heart, believing it to be a blood-clot, but stating that a sarcoma had to be considered.

Byrom Bramwell,[22] in 1875, reported a case of sarcoma of the heart, and later in his book on *Diseases of the Heart and Thoracic Aorta* corrected the diagnosis and stated that it was not a primary but a secondary tumor.

A myxosarcoma hematodes was reported by Wiegand.[23] Most writers class this case as myxoma. The same is to be said of Salvioli's[24] case. Prudhomme's[25] case, counted by Fraenkel as primary sarcoma, seems to have been a secondary melanotic sarcoma to judge from the clinical history and pathological description, but no microscopic examination was made. Of the cases reported in recent years, those of Méroz and Ménétrier appear doubtful to Thorel.[26]

Reviews of the literature have been made by Bodenheimer, Berenson, Fraenkel, Link, Karrenstein, Ehrenberg and others. In fact, nearly every writer who reports a new case mentions some of the cases which were previously reported. Ehrenberg, who gives the most complete review of sarcoma of the heart, in 1911, reported 19 cases. Two of his cases, those of Byrom Bramwell and Crawfurd, are not included in the following summary. There are some cases which are not controlable in a clinical or pathological respect, but it is difficult to know where to draw the line. In some the description is incomplete or unclear, in some the clinical description is not obtainable or no microscopic examination has been made. Birch-Hirschfeld's case is only mentioned.

Of the 30 cases which I was able to find in the literature only 3, including that of the author, are reported in American journals. The majority, 19 cases, are found in the German medical literature, 3 are English publications, 4 are reported in French, 1 in Italian and 1 in Swedish. It seems that tumor of the heart furnishes a favorite subject for dissertations for obtaining the M.D. degree. Eight cases among these 31 are reported as dissertations.

A correct clinical diagnosis was not made in any instance. Seven times the diagnosis of tumor of the mediastinum was made, once of intrathoracic tumor and once of cancer of the lung. Myocarditis was the diagnosis 4 times and pericarditis with effusion twice.

Besides these diagnoses a good many others were made which were not related to the heart disease, as encysted effusion and solidification of the lung, bronchopneumonia, edema of the lung, pleurisy with effusion, tuberculosis serosa, hemiplegia, bronchitis, scarlet fever, diphtheria, aneurysm, etc.

Sarcoma of the heart occurs at all ages. The two youngest were three and seven years old respectively; the oldest were seventy-two, seventy-six and seventy-nine years of age. All other patients were between the ages of eighteen and fifty-eight.

As regards the sex this disease apparently favors the male. Of our cases 18 were males and 10 females.

I am not able to give a detailed description and a complete picture of the clinical condition in the appended table on account of lack of space, and only mention those symptoms and signs which seem to me the most important, but it is evident that in the majority of cases the symptoms are produced by seriously disturbed cardiac activity. In most cases we find some of the following symptoms, venous congestion and stasis, cyanosis, pleural or pericardial effusion, edema of the legs and other parts of the body, edema of the lung, ascites, dyspnea, palpitation of the heart, irregular pulse, cough, etc. In only a few cases were heart murmurs heard. Repeated aspirations of bloody fluid from the pleural cavity were done only in Raw's and the author's cases. Repeated aspirations of bloody fluid from the pericardial cavity, which, according to Fraenkel, is of considerable diagnostic importance, was done only in his own case. Sudden death without previous symptoms occurred in 3 cases. In 21 cases the disease lasted from one month to three and a half years.

From a histological point of view there are:

Spindle-cell sarcomas	10
Round-cell sarcomas	6
Giant-cell sarcomas	4
Myxosarcomas	3
Fibrosarcomas	3
Mixed-cell sarcomas	2
Angiosarcoma	1
Lymphosarcoma	1

Eight cases of our series, including that of the author, are sarcomas of the pericardium. Of these Broadbent's case is apparently confined to the pericardium (only the chest was examined). In Drysdale's case and Lambert's case there was a general sarcomatous infiltration of the myocardium.

The cystic tumor reported by Kaak was in the upper part of the pericardium, connected with the pericardium and the large veins. Redtenbacher's angiosarcoma of the pericardium contained a cavity which was in communication with the right ventricle. In Schöppler's case there was a general sarcomatosis of the epicardium, the entire heart being enveloped in sarcomatous tissue. In Tobieson's case the tumor masses were mostly on the surface of the

pericardium; these tumors were chiefly in the pericardial cavity or on the surface of the pericardium. The author's case seems to take a special place by taking its origin in the subepicardial areolar tissue, being covered by both layers of the pericardium.

The seat of the tumor was as follows:

	Cases.
Pericardium	8
Right auricle	11
Left auricle	6
Right ventricle	1
Right and left auricle	1
Ventricular septum	1
Aortic valve	1
Left ventricle and auricle	1

The size varied from that of a walnut to that of a child's head.

Metastases were found in 10 cases as follows:

	Cases.
In the liver	2
In the pancreas	2
In the lung	1
In the suprarenals	2
In the pleura and mediastinal lymph nodes	1
In the tracheal lymph nodes and suprarenals	1
In the lung and pararenal tissue	1

Among the postmortem findings stasis due to interference with

In the lung and pararenal tissue	1

Among the postmortem findings, stasis due to interference with the circulation was the most common condition. Pleural effusion was found in 13 autopsies (four times bloody); pericardial effusion in 10 cases (five times bloody). The pericardium was partly or entirely obliterated 5 times.

SUMMARY OF REPORTED CASES.

No. 1. Baldwin, *Jour. Am. Med. Assn.*, 1910, lx, 635. Clinical diagnosis: Encysted effusion or solidification of bases of both lungs. Age and sex: thirty-four years; male. Main clinical symptoms: Dyspnea; edema of ankles; diffuse rales in both sides; flatness of both bases; bloody expectoration; cough; enlargement of heart. Duration and nature of tumor: Five months; large spindle-cell sarcoma. Location and size: Left auricle; 5 x 6 x 7 cm. Other postmortem findings: Organized blood-clot at base of left lung; dilatation of right side of heart. Remarks: A pedunculated tumor originating from the margin of the pulmonary veins. No metastases.

No. 2. Binder, *Frankfürter Ztschr. f. Path.*, 1914, xv, 194. Clinical diagnosis: Aneurysm; tumor of mediastinum. Age and sex: Thirty-three years; male. Main clinical symptoms: Dyspnea; edema of face, thorax, later of legs; venous telangiectasis of abdomen and thorax; no ascites. Duration and nature of tumor: Fifty days; spindle-cell sarcoma. Location and size: Right auricle; right auricle nearly filled. Other postmortem findings: Bilateral pleural serous effusion. Remarks: A tumor which is

pedunculated, of the size of a walnut, hangs down from the right auricle into the vena cava. No metastases.

No. 3. Birch-Hirschfeld, *Lehrbuch der Path.*, 1876, p. 360. Nature of tumor: Giant-cell sarcoma. Location and size: Right auricle; walnut. Remarks: Origin in endocardium and right auricle. No other data.

No. 4. Bodenheimer, *Dissertation*, Bern, 1865. Clinical diagnosis: Heart disease of unknown origin. Age and sex: Forty-four years; male. Main clinical symptoms: Edema of upper and lower extremities; ascites; pericarditis with effusion; dulness of both bases; rales; sanguino-muco-purulent expectoration; sudden death. Duration and nature of tumor: Two months; sarcoma. Location and size: Right auricle mainly; 30 x 20 cm. Other postmortem findings: Pericarditis with effusion; right pleural effusion. Remarks: A tumor consisting of about 20 nodules on the anterior surface of the right and left auricle, growing into the cavity of the right auricle. No metastases.

No. 5. Broadbent, *Tr. Path. Soc.*, London, 1889, lxxxii, 39. Age and sex: Twenty-three years; male. Main clinical symptoms: Shortness of breath; signs of fluid in left chest and pericardium. Duration and nature of tumor: Three months; lymphosarcoma. Location: Pericardium. Other postmortem findings: Bloody pericardial effusion; fibrous pleurisy. Remarks: Pericardium 0.5 to 1.5 cm. thick; does not collapse after fluid is removed. No other part examined, but there did not seem to be any metastases.

No. 6. Crescenzi, *Monatschr. f. Kinderheilk.*, 1906–07, v, 369. Clinical diagnosis: Scarlet; diphtheria; bronchopneumonia. Age: Three years. Main clinical symptoms: Fever; scarlet eruption; diphtheria bacillus and streptococcus culture from throat; pharyngitis; bronchopneumonia. Duration and nature of tumor: Three months; sarcoma globocellulare. Location: Ventricular septum. Remarks: An intramural growth; does not reach endocardium. Tumor is in initial period of development. Posterior ventricular walls slightly infiltrated. No metastases.

No. 7. Drysdale, *Tr. Path. Soc.*, London, 1903, liv, 311.. Age and sex: Forty-three years; female. Main clinical symptoms: Dyspnea; edema of legs; in state of collapse on admission; puerperal insanity; died after three days. Duration and nature of tumor: Eight months; round and oval-cell sarcoma. Location: Pericardium infiltrating myocardium extensively. Other postmortem findings: Obliterative pericarditis; pulmonary artery compressed. Remarks: Metastases in liver.

No. 8. Escher, *Dissertation*, Leipzig, 1909. Clinical diagnosis: Emphysema of lung; dilatation of heart. Age and sex: Seventy-two years; female. Main clinical symptoms: Shortness of breath; edema of legs; later edema of left arm and left chest. Duration and nature of tumor: One year; round-cell sarcoma. Location: Right auricle mainly. Other postmortem findings: Edema of legs;

arteriosclerosis; subpleural hemorrhage. Remarks: Pericardium obliterated and infiltrated with tumor tissue; tumor nodules on surface of pericardium. Metastases in tracheal lymph nodes and in suprarenal.

No. 9. Ehrenberg, *Deutsch. Arch. f. klin. Med.*, 1911, ciii, 293. Clinical diagnosis: Tumor of mediastinum, with compression of superior vena cava. Age and sex: Forty-nine years; male. Main clinical symptoms: Dyspnea; cyanosis; edema of upper half of body, head and upper extremities; enlargement of veins on upper abdomen and thorax; roentgen-ray; shadow to right of sternum. Duration and nature of tumor: Four months; polypoid giant-cell sarcoma. Location and size: Right auricle; right auricle filled. Other postmortem findings: Right pleural serous effusion; serous pericardial effusion. Remarks: Venæ cavæ, part of anonyma and azygos dextra filled by tumor tissue.

No. 10. Ely, *Thèse de Paris*, 1877, cited from Ehrenberg[4] and Méroz.[11] Age and sex: Twenty-eight years; male. Main clinical symptoms: Had been in hospital several times for bronchitis; died suddenly without sickness preceding death. Duration and nature of tumor: Sudden death; sarcoma. Location: Anterior wall of left ventricle. Remarks: No metastases.

No. 11. Erickson, *Upsala Läkarf. Förch.*, 1908, Band xiii, Hef; 6, cited from Méroz.[11] Clinical diagnosis: Myocarditis; bront chitis; pulmonary edema. Age and sex: Thirty-six years; male. Main clinical symptoms: Symptoms of myocarditis, bronchitis and pulmonary edema. Nature of tumor: Fibrosarcoma. Location: Left auricle. Remarks: A fibroma, with sarcomatous changes marked in places. No metastases.

No. 12. Fuhrman, *Dissertation*, Marburg, 1899. Age and sex: Seven years; female. Main clinical symptoms: Sudden death; had had a slight headache for two days. No other symptoms. Duration and nature of tumor: Sudden death; spindle-cell myxosarcoma. Location: Aortic valve. Remarks: Grape-like appearing tumors, obliteration of the right coronary artery by a tumor in front of it. Left coronary artery is occluded by a plug of tumor tissue. No metastases.

No. 13. Fuhrman (second case), *Dissertation*, Marburg, 1899. Age and sex: Thirty-four years; male. Main clinical symptoms: Palpitation of heart; cough; fatigue; weakness; frothy sputum; cyanosis; dyspnea; no edema; no murmurs. Duration and nature of tumor: Six months; spindle-cell sarcoma with giant cells. Location: Left auricle. Other postmortem findings: Left pulmonary vein obliterated by tumor. Remarks: This case had been reported as a myoma by Justi. Two tumors in the left auricle arising from the median and lateral wall. Small tumor the size of a bean on the mitral valve. No metastases.

No. 14. Fraenkel, *Festschr. zur Eröffnung d. Krankenhauses Hamburg-Eppendorf*, 1889, p. 102. Clinical diagnosis: Pericardi-

tis, left serous; infarct in right lower lobe of lung. Age and sex: Eighteen years; female. Main clinical symptoms: Pericarditis with bloody effusion; pleurisy with serous effusion; dyspnea; cyanosis; weak irregular pulse; bloody sputum; flatness in both lower lobes. Duration and nature of tumor: Fifty days; spindle-cell sarcoma. Location and size: Right auricle; 8 x 7 x 4.5 cm. Other postmortem findings: Atelectasis of left lower lung. 1.5 liters of serous fluid in the pericardium. Remarks: The pericardium was aspirated four times; 300, 1000, 80 and 750 c.c. of bloody fluid were obtained. No metastases.

No. 15. Fraenkel, *München. med. Wchnschr.*, 1901, No. 1, xlviii, 648 (summary). Main clinical symptoms: Symptoms of seriously disturbed cardiac activity. Nature of tumor: Mixed giant-cell sarcoma. Location: Apex of right ventricle. Remarks: No metastases.

No. 16. Geipel, *Zentralbl. f. allg. Path.*, 1899, x, 846. Age and sex: Fifty-three years; female. Main clinical symptoms: Left-sided apoplexy. Nature of tumor: Round-cell sarcoma. Location and size: Right auricle; 5.5 x 4.5 x 4 cm. Other postmortem findings: Pericardial cavity obliterated except for an area the size of the palm of the hand; destruction of last half of corpus striatum, the largest part of the internal capsule and insula. Remarks: Right auricle nearly filled by tumor, which is attached by a pedicle to the interauricular septum and adjacent area; right ventricle wall also infiltrated. No metastases.

No. 17. Horneffer and Gautier, *Revue méd. de la Suisse romande*, 1913, xxxiii, 57. Clinical diagnosis: Bronchitis; cardiorenal disease; myocarditis. Age and sex: Forty-three years; male. Main clinical symptoms: Symptoms of bronchitis for two years; bloody sputum; dizziness; weak limbs; vertigo; fainting spells; arrhythmia; murmurs at base of heart; dyspnea. Duration and nature of tumor: Two years intermittently; myxosarcoma. Location and size: Left auricle; 6 x 5 x 2 cm. Other postmortem findings: Pericardial effusion; right pleural effusion. Remarks: Cauliflower-like pedunculated growth reaching down to mitral valve and sending prolongations through it. The tumor grows through the auricle wall appearing on its surface. No metastases.

No. 18. Hottenroth, *Dissertation*, Leipzig, 1870. Clinical diagnosis: Chronic bronchitis; pleural effusion. Age and sex: Seventy-nine years; female. Main clinical symptoms: Marantic and emaciated; various kinds of rales; signs of fluid in chest. Nature of tumor: Giant-cell sarcoma. Location and size: Right auricle; hen's egg. Other postmortem findings: Right auricle dilated; vena cava dilated. Remarks: Growth is cauliflower-like. No metastases.

No. 19. Juergens, *Berl. klin. Wchnschr.*, 1891, xxviii, 1031. Age and sex: Thirty-sex years; male. Duration and nature of tumor: Sudden death on street; fibrosarcoma. Location: Right auricle

mainly. Other postmortem findings: Tricuspid valve narrowed. Remarks: Diffuse infiltration of wall of right auricle, tendons of tricuspid valve and wall of right ventricle.

No. 20. Kaak, *Dissertation*, Kiel, 1904. Clinical diagnosis: Myocarditis with marked disturbance in compensation. Age and sex: Twenty-seven years; male. Main clinical symptoms: Cough and pain in both axillæ; dyspnea; edema of legs, back and eyelids; ascites; dulness at bases of both lungs; pleuritic friction rub. Duration and nature of tumor: Four weeks; myxocystosarcoma. Location: Pericardium. Other postmortem findings: Two hemorrhagic infarcts in lung; edema of bases of lungs; bilateral pleural effusion; ascites; edema. Remarks: The tumor is in the upper part of the pericardial cavity connected with the pericardium and large vessels. It is partly cystic; one large cyst, 11 cm. long, hangs down from the lower portion of the tumor. Two thoracenteses done, 1700 c.c. of yellowish fluid at second aspiration.

No. 21. Lambert, *New York Med. Jour.*, 1898, lxvii, 210. Clinical diagnosis: Pneumonia; pericardial effusion; bilateral pleurisy, with effusion; mediastinal tumor at root of right lung. Age and sex: Thirty-nine years; male. Main clinical symptoms: Signs of pneumonia, which only partly cleared up; developed bilateral serous effusion; cyanosis; ascites; pericardial effusion; edema of upper part of body. Duration and nature of tumor: Thirty-seven days; small round-cell sarcoma. Location: Visceral surface of pericardium; myocardium diffusely infiltrated. Other postmortem findings: Fibrinous pericarditis, with bloody effusion. Remarks: Nodular growth covers inner surface of pericardium; wall of left ventricle extensively infiltrated; nodules in other parts of myocardium. Metastatic nodule in head of pancreas.

No. 22. Link, *Ztschr. f. klin. Med.*, 1909, lxii, 272. Clinical diagnosis: Tumor of mediastinum. Age and sex: Twenty-three years; male. Main clinical symptoms: During the twenty months preceding death he was four times in the hospital with dyspnea, pain in the heart region, cough, cyanosis, pericarditis, pleural effusion; last time had edema, thrombosis of external jugular vein bloody sputum. Duration and nature of tumor: Twenty-one months; spindle-cell sarcoma. Location and size: Right and left auricle; heart and tumor were size of a child's head. Other postmortem findings: Pericardial cavity mostly obliterated; bilateral pleural effusion. Remarks: Upper border of the tumor, which is at innominate vein, measures 15 cm. Almost nothing is left of the walls of the auricle. The walls of the ventricle are preserved. Roentgen-ray showed increase in shadow of heart to right and left in upper part.

No. 23. Ménétrier, *Acad. de méd. de Paris*, March 7, 1911 (cited from *Zentralbl. f. Herzkrank.*, iii, 208.) Age and sex: Thirty-five years; male. Main clinical symptoms: Edema of body below diaphragm; dyspnea; bloody pleural effusion; hemoptysis. Nature

of tumor: Myxosarcoma, with fusiform cells. Location and size: Left auricle; 6 cm. Other postmortem findings: Infarcts in lung; hemorrhagic effusion in pleural cavity. Remarks: Tumor compresses right auricle and interferes with circulation. Edema entirely below diaphragm suggests compression of inferior vena cava.

No. 24. Méroz, *Thèse*, Geneva, 1911. Clinical diagnosis: Mitral regurgitation; left pleurisy; cancer of lungs. Age and sex: Fifty-five years; female. Main clinical symptoms: Pain in left side; pain on respiration; dyspnea; scattered rales and dulness; mitral regurgitation; systolic murmur; pleural effusion; edema of lungs. Duration and nature of tumor: Two months; spindle-cell sarcoma. Location and size: Left auricle; hen's egg. Other postmortem findings: Left pleural cavity contains 2000 c.c., and pericardium 100 c.c. of purulent fluid. Remarks: The tumor hangs down into the left ventricle through the enlarged mitral valve. No metastases.

No. 25. Raw, *British Med. Jour.*, 1898, ii, 1335. Clinical diagnosis: Tumor of mediastinum. Age and sex: Forty-three years; female. Main clinical symptoms: Continual pain in chest for three and one-half years; dyspnea; ascites; edema of legs; dulness in right chest; outward displacement of heart; hemothorax; murmur at base of heart. Duration and nature of tumor: Three and a half years; fibrosarcoma. Location and size: Right auricle 3 x 3 x 3¼ cm. Other postmortem findings: Bacillus aërogenes capsulatus in blood; lumbar veins enlarged; inferior vena cava nearly empty. Remarks: Repeated aspirations of thorax gave bloody fluid from chest. Growth extends continuously from right auricle through inferior vena cava to under surface of liver. Microscopically it appears as fibroma, containing clusters of round cells; this and metastasis in liver suggests fibrosarcoma.

No. 26. Redtenbacher, *Wien. klin. Wchnschr.*, 1889, ii, 214. Clinical diagnosis: Serous membrane tuberculosis. Age and sex: Twenty-two years; male. Main clinical symptoms: Symptoms of pericarditis; frothy expectoration; effusion into both pleural sacs; later into abdomen; dyspnea and hydrops very marked. Duration and nature of tumor: Four months; angiosarcoma of pericardium. Location and size: Pericardium; palm of hand. Other postmortem findings: The abdomen contains 6 liters, the right pleural cavity ½ liter, the left 2 liters of serous fluid; the heart 100 c.c. of bloody fluid; the pericardium is adherent to the heart except at the apex. Remarks: Over right auricle and part of right ventricle is a blood-containing cavity communicating with right ventricle. Metastases in right lung.

No. 27. Schoeppler, *München. med. Wchnschr.*, 1906, xlv, 2197. Clinical diagnosis: Hemiplegia. Age and sex: Seventy-six years; female. Main clinical symptoms: Unconscious on admission; demented and delirious; pericardial friction rub; systolic murmur at apex; right-sided paralysis, which disappeared. Nature of

tumor: Round-cell sarcoma of epicardium. Location: Covers entire heart. Other postmortem findings: Fibrinous pericarditis. Remarks: Died three months, twenty-four days after admission; no history obtainable; the entire heart is enveloped in nodular irregular sarcomatous tissue. Metastasis on left surface of suprarenal.

No. 28. Sternberg, *Zentralbl. f. Herzkrank.*, 1910, ii, 151. Clinical diagnosis: Myocarditis. Age and sex: fifty-eight years; female. Main clinical symptoms: Dyspnea; edema of ankles; enlargement of heart; incomplete examination on account of low condition of patient. Duration and nature of tumor: Two months; spindle-cell sarcoma. Location: Wall of left ventricle; in right and left auricles. Other postmortem findings: Hemorrhagic fluid in right pleural cavity; infarct in lung; hemorrhagic pericardial effusion: Thrombosis of many branches of pulmonary artery. Remarks: Vena magna cordis filled with tumor tissue which projects like a polypoid growth into right auricle. A large tumor nodule in left auricle grows out of right pulmonary vein, which is completely filled with tumor tissue. Metastasis in tail of pancreas.

No. 29. Tobieson, *Ztschr. f. klin. Med.*, 1912, lxxv, 53. Clinical diagnosis: Intrathoracic tumor. Age and sex: Eighteen years: male. Main clinical symptoms: Irregular heart; fever; friction rub over nipple; cough; decreased breathing beneath scapula; enlargement of heart; systolic murmur at pulmonary region; thrombosis of jugular vein; edema; cyanosis; dyspnea; pleural effusion; gangrene of nose. Duration and nature of tumor: Nine months; spindle-cell predominating. Location and size: Internal surface of pericardium; man's head. Other postmortem findings: Bilateral pleural effusion (bloody); pericardium filled with coagulated blood. Remarks: The tumor masses mostly on the internal surface of the pericardium are flat or nodular; the vena cava superior is completely compressed and no lumen is left. Metastases in lung.

No. 30. Weiss, *Gazz. med. ital. Prov. Venete*, 1880, xxiii, 301. Clinical diagnosis: Tumor of anterior mediastinum; compression of pulmonary artery and descending vena cava. Age and sex: Thirty-eight years; male. Main clinical symptoms: Cyanosis; edema of upper part of body, head and upper extremities, especially the left side; decreased pericardial dulness; dulness at bases of lungs; cardiac palpitation; dyspnea; left pleural effusion. Duration and nature of tumor: Thirty-four days; large round cell predominating. Location and size: Right auricle mainly; child's head. Other postmortem findings: Edema of upper part of body, lung and cerebrum; thrombus of descending vena cava; interstitial hepatitis; obliterated pericardium; bilateral serous pleural effusion. Remarks: The tumor with the heart and the obliterated pericardium formed a large mass the size of a child's head. The tumor was mainly in the right auricle and had broken through the interauricular septum; myocardium of right auricle largely replaced by

tumor tissue, that of the other chambers extensively infiltrated. Tumor masses enveloped the heart. Metastases in lung and pararenal tissue.

No. 31. Perlstein. Clinical diagnosis: Tumor of mediastinum. Age and sex: Forty-three years; male. Main clinical symptoms: Dyspnea; cough; perspiration; restlessness; thirst; weakness; hemothorax. Duration and nature of tumor: Thirty-one days; Mixed-cell sarcoma. Location and size: Pericardium; 13 x 8 x 5 cm. Other postmortem findings: Chronic obliterative pericarditis; hemothorax; anemia; interstitial pneumonia; lobar pneumonia; chronic emphysema. Remarks: A well-defined tumor originating in the subepicardial adipose tissue located essentially between heart and epicardium, invading the pericardial membranes and fat. The myocardium is not invaded. Metastases in mediastinal lymph nodes and in pleura.

CONCLUSIONS. 1. Only 30 cases of sarcoma of the heart were found after a careful search of the literature. To these is added a case in which the tumor originated apparently in the subepicardial areola tissue.

2. There is no characteristic clinical picture for the condition. The symptoms are mostly those of seriously disturbed cardiac activity. Excessive and repeated hemothorax was the most striking clinical feature of the case reported.

3. Sarcomas of the heart occur at all ages, but are most common in the vigorous years of life.

4. Histologically all types of sarcoma have been reported. The spindle-cell variety is the one most often found.

5. They occur more often in the auricles than in the ventricles, and more frequently on the right than on the left side.

6. Among the postmortem findings, pericardial and pleural effusions and edema are common.

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STUDIES IN CHOLELITHIASIS.

I. THE DISTURBANCES OF THE CHOLESTERIN METABOLISM AS A FACTOR IN GALL-STONE FORMATION.

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In this communication our present knowledge of the cholesterin metabolism is summarized and the importance of a hypercholesterinemic state both in the blood and bile as an etiological factor in the production of gall-stones is emphasized. The various elements in gall-stone formation are studied. These are the relationships of food to the cholesterin content of the blood and bile and the effect of bacterial infection and of an unknown variable factor which in a later communication will be discussed under the term of "cholesterin diathesis."

Bile. The chemical composition of bile has been investigated by numerous workers and the relative proportions of its various constituents have been found to be variable. This is readily explained when one analyzes the chemical methods in use during earlier periods as well as the various factors present in the individual cases at the time the analyses were made. Necessarily for this purpose biliary fistulæ of one kind or another must be made, and these immediately introduce abnormal factors. In addition, in practically all of the cases studied, pathological conditions have existed. Frerichs[1] examined the bile of two healthy people who had been killed accidentally; von Gorup-Besanez[2] examined the bile of a man, aged forty-nine years, and of a woman, aged twenty-nine years. Hammersten[3] examined the human liver bile in 3 cases.

[1] Hoppe-Seyler: Physiologische Chemie, p. 299.
[2] Ibid.
[3] Physiological Chemistry, English translation, New York, 1906.

The results of all of these are tabulated, the figures indicating parts per thousand:

TABLE I.—FRERICHS.[4]

	1.	2.
Water	860.0	859.2
Solids	140.0	140.8
Bile salts	72.2	91.4
Mucus and pigments	26.6	29.8
Cholesterin	1.6	2.6
Fat	3.2	9.2
Inorganic substances	6.5	7.7

TABLE II.—VON GORUP-BESANEZ.[5]

	1.	2.
Water	822.7	898.1
Solids	177.3	101 9
Bile salts	107.9	56.9
Mucus and pigments	22.1	14.5
Cholesterin and fat	47.3	30.9
Inorganic substances	10.8	6.2

TABLE III.—HAMMARSTEN.[6]

	1.	2.	3.
Solids	25.200	35.260	25.400
Water	974.800	964.740	974.600
Mucin and Pigments	5.290	4.290	5.150
Bile salts	9.310	18.240	9.040
Taurocholate	3.034	2.079	2.180
Glycocholate	6.276	16.161	6.860
Fatty acids from soaps	1.230	1.360	1.010
Cholesterin	0.630	1.600	1.500
Lecithin and fat	0.220	1.530	1.260
Soluble salts	8.070	6.760	7.250
Insoluble substances	0.250	0.490	0.210

Our investigations have been devoted to determinations of the cholesterin content of bile obtained from biliary fistulæ leading into the gall-bladder, the hepatic or the common bile ducts, made during the course of operations upon patients for various diseased conditions of the bile passages with and without stone formation. The methods of Autenrieth and Funk[7] and Bloor[8] were employed for these analyses, and occasionally these were verified by recourse to the Windaus[9] method. The older methods are subject to much criticism. Our determinations were made in duplicate and were checked up in various ways. Many determinations were made in each case, and the comparative results may therefore be regarded as true indices. Our results in normal bile have given values for the cholesterin contents varying between 20 and 80 mg. per 100 c.c.

[4] Loc. cit. [5] Loc. cit. [6] Loc. cit.
[7] München. med. Wchnschr., 1913, lx, 1243.
[8] Jour. Biol. Chem., 1915–16, xxiv, 227.
[9] Ztschr. f. physiol. Chem., 1910, lxxv, 110.

It is proper to consider the bile as a colloidal solution, the cholesterin being held in suspension by means of the bile salts, acids, fats and lecithin dissolved in the same. Such a compound mixture is subject to the ordinary physical and chemical laws. Precipitations of any of the ingredients may follow supersaturation or a disturbance of the normal equilibrium. It is conceivable that a bacterial infection causing an inflammatory response in the gall-bladder wall, with its consequent exudation of electropositive serum-albumin, will also cause the precipitation of the ingredients of an electronegative solution.

The supersaturation may be only relative, owing to the fact that the amount of bile salts in solution may be above or below the normal content. In test-tube experiments it has been shown that an increase of the dissolved bile salts may enable the bile to take up an extraordinary amount of cholesterin. The converse of this has also been shown.

The idea of supersaturation was well illustrated in the case of a patient in whom at operation the gall-bladder was drained. The bile obtained from the gall-bladder and that which drained away in the first twenty-four hours was, macroscopically, a thick emulsion which, microscopically, was seen to be due to large masses of cholesterin crystals. The remarkable figure of 850 mg. of cholesterin for each 100 c.c. of bile was obtained.

The same idea has also been corroborated in some animal experiments. Anitschkow and Chalatow[10] have shown that when the cholesterin content of the bile of rabbits becomes markedly increased, concrements are deposited within the gall-bladder consisting of pure cholesterin. Dewey[11] has also recently produced small stones in the gall-bladders of hypercholesterinized animals.

It has usually been found that the bile obtained from the gall-bladder has a higher cholesterin content than bile obtained from the ducts. This, however, is only true for the first two or three days after drainage is instituted. The discrepancy is accounted for by the fact that a certain amount of stagnation takes place in the gall-bladder as well as by an increase in the cholesterin of the inflammatory exudate.

Blood. In ascertaining the cholesterin content of the blood, similar methods were employed, and in normal persons the values were found to vary between 150 and 180 mg. per 100 c.c. of blood. Our results have corresponded with those of other workers, as follows: Chauffard, Laroche and Grigaut,[12] 150 to 180 mg. per 100 c.c. blood; Widal, Weill and Laudat,[13] 174 to 195 mg. per 100 c.c. blood; Bacmeister and Havers,[14] 110 to 180 mg. per 100 c.c. blood.

[10] Centralbl. f. allg. Path., 1913, xxiv, 1.
[11] Arch. Int. Med., 1916, xvii, 757.
[12] Compt. rend. Soc. de biol., Paris, 1911, lxx, 336.
[13] Soc. Biol., 1911, lxiv, 883.
[14] Deutsch. med. Wchnschr., 1914, No. 8.

THE RELATIONSHIP OF FOOD, BLOOD AND BILE. The question as to whether the cholesterin of the food is absorbed is of paramount importance. The investigations of Doree, Ellis, Fraser and Gardner[15] offer excellent prooof of such absorption. Divergent results have been obtained by other authors on account of the types of animals employed and because of the artificial conditions produced in the experiments. Pribram,[16] Fraser and Gardner,[17] Grigaut and L'Huillier,[18] Anitschkow and Chalatow,[19] Wasker,[20] Weltman and Biach[21] and Rothschild[22] have proved conclusively that cholesterin fed to rabbits is absorbed and that an extensive feeding is followed by an increase in the cholesterin content of the blood. The last named proved further that the cholesterin content of the blood of rabbits must increase to a certain stage before any increase appears in the bile. This was demonstrated in the following table:

TABLE IV—ROTHSCHILD.[23]

	Cholesterin content of blood in mgm. per 100 c.c.							Cholesterin content of the bile mgm. per 100 c.c.
No.	Before feeding.	7th day.	14th day.	28th day.	40th day.	59th day.	150th day.	
180	40	90	..	...	...	...	...	10–15
183	50	..	98	...	...	...	...	10–15
170	48	..	..	130	...	...	...	35
157	45	..	..	...	280	...	...	90
190 A	..	..	..	...	...	300		
174 A	..	..	..	...	...	100		
87 A	..	..	..	...	...	...	364	164

It was also shown (Rothschild) that in hypercholesterinemic rabbits, in which unilateral or bilateral adrenalectomy had been performed, the cholesterin content of the bile increased similarly to that of the blood. The same phenomenon was demonstrated in animals starved for varying lengths of time.

Kusumato[24] showed that in dogs the cholesterin content of the bile rose after poisoning with toluylendiamin.

In dogs it is more difficult to produce hypercholesterinemic states, inasmuch as the absorbed cholesterin is excreted very rapidly. Furthermore, all experiments in dogs in whom biliary fistulæ have been established are practically valueless. Rothschild showed in dogs that with occlusion of the common bile duct, cholesterin in the food was poorly absorbed, but that it was more easily absorbed when mixed with bile. In an animal with a biliary fistula the loss

[15] Proc. Roy. Soc., 1908, 1909, 1910, 1912.
[16] Biochem. Ztschr., 1908, vii, 152.
[17] Ibid.
[18] Soc. Biol., lxxiii, 304.
[19] Ibid.
[20] Ztschr. f. physiol. Chemie, 1912, 80.
[21] Ztschr. f. exper. Path. u. Therap., 1913, xiv, 367.
[22] Ziegler's Beitrage, 1914–15, 60, 39 and 66.
[23] Loc. cit.
[24] Biochem. Ztschr., 1908, xiii, 334.

of cholesterin through the escaping bile as well as the poor absorption brought about by the more or less total exclusion of bile from the intestinal tract brings about a negative balance in which the intake is less than the output.

Important evidence is also available from comparative physiological sources to show the close relationship between the cholesterin contents of food, blood and bile. Herbivora, such as rabbits and guinea-pigs whose food is poor in cholesterin, have a lower cholesterin content in their blood and bile. The quantities are so small that Weltman and Biach[25] have even denied its presence in the bile. Dogs aud cats, as types of carnivora, whose diets are richer in cholesterin, show a much higher colesterin content of blood and bile. Pigs, as examples of omnivora, show high cholesterin contents of blood and bile. The conclusions of Weltman and Biach[26] in regard to a difference in principle of the cholesterin metabolism of herbivora and carnivora were shown to be unwarranted (Rothschild),[27] inasmuch as the difference is only one of degree of activity of the liver as a filter.

In humans, who are omnivorous animals, the cholesterin content of the blood and bile is comparatively high. The actual content varies markedly with different races and the differences are found to correspond closely with the diets of the people. De Langen[28] recently reported a series of observations made among the natives of Java, China, Japan and India. The cholesterin content of the bloods of these people was found to average 40 to 50 per cent. less than that of Europeans. This corresponds with the diet, poor in cholesterin, which is customary in those parts of the world. These races, in fact, can be classed with the herbivorous animals in contradistinction to the Europeans, who have omnivorous dietary habits.

In the cases which we have studied it has been usually found that immediately following the making of a complete biliary fistula the cholesterin content of the escaping bile is high. Thereafter it falls irregularly and continuously during the first few days, during which period the diet of the patients consists of fluids devoid of, or poor, in lipoid materials. The cholesterin content of the bile begins to rise as soon as fats are added to the diet. So characteristic is this phenomenon that the person making the daily determinations of the cholesterin content of the bile can easily tell on which day the diet of the patients has been increased in fats.

Among the patients who undergo operation for the cure of cholelithic conditions it is found that a certain number develop recurrent symptoms a shorter or longer time after recovery from the operation. In some of these, determinations of the lipoid content of the blood has demonstrated a continuously hypercholesterinemic condition. It has been found a matter of ease to cause a large decrease in this

[25] Loc. cit. [26] Loc. cit. [27] Loc. cit.
[28] Presse médicale, 1916, No. 42, 332.

cholesterin content by simply excluding from the diet all lipoid bodies. Conversely, the cholesterin blood content has always been seen to rise again to high figures whenever these patients have returned to their ordinary diets or whenever, for one or another purpose, the lipoid content of the food administered to these patients has been increased.[29]

Bacteriology of Gall-stones. Evidence of a bacteriological nature in regard to the causative factor in the mechanism of gall-stone formation has been reported since 1886, when Gallipe[30] first suggested the microbic origin of biliary calculi. Eight years previously Bernheim[31] had drawn attention to the clinical connection between typhoid fever and infection of the biliary passages. Welch,[32] in 1890, found colon bacilli and staphylococci in the interior of gall-stones, and three years later Chiari[33] was able to demonstrate the presence of typhoid bacilli. One year later Gilbert and Dominici[34] found colon bacilli in 23 out of 70 cases, and later showed experimentally that colon and typhoid bacilli could cause inflammation of the gall-bladder leading to stone formation. Mignot[35] succeeded in producing gall-stones in animals by the employment of typhoid, colon and subtilis bacilli and staphylococci and streptococci. Milian and Hanot,[36] in 1896, found typhoid bacilli in the center of recently formed stones. Cushing, Halstead, Richardson and others have contributed useful facts in the connection between typhoid fever and gall-stone formation.[37]

The recent work of Rosenow[38] in the bacteriology of gall-stones and in the production of experimental cholecystitis by the injection of streptococci is of much interest. It is necessary to remember that these two conditions, while frequently coexisting, are not necessarily a part of the same pathological process, inasmuch as they can and do occur independently of one another. In the examination of a large number of stones it is of special interest to point out that Rosenow obtained sterile cultures from four typical cholesterin stones, while in the mixed stones he obtained a variety of organisms. This lends rather strong support to the theory of the non-bacterial origin of pure cholesterin stones.

The discussion of the last factor indicated in the opening paragraph of this communication is reserved for a future paper. Suffice

[29] These postoperative studies will be reported in a later communication.
[30] Compt. rend. Soc. de biol., Paris, 1886, p. 116.
[31] Dict. Encyclop., De Dachambre: Article "Ictere."
[32] Quoted from Allbutt and Rolleston: System of Medicine, London, 1908, iv, pt. 1, 254.
[33] Ztschr. f. Heilk., 1893, xv, 199.
[34] Compt. rend. Soc. de biol., 1894.
[35] Bull. de la Soc. anat. de Paris, 1898, No. 12.
[36] Quoted from Allbutt and Rolleston: System of Medicine, London, 1908, iv, pt. 1, 254.
[37] Quoted from Allbutt and Rolleston: System of Medicine, London, 1908, iv, pt. 1, 254.
[38] Jour. Inf. Dis., 1916, xix, 527.

it to say here that a hypercholesterinemic condition may appear in the body economy, less frequently having its inception in some pathological disturbance of the normal metabolic activity, much more frequently owing to its origin to temporary, and apparently, necessary changes of the normal functions accompanying the physiological period of pregnancy. These disturbances may be repeated from time to time or may become continuous, and are found to precede or to be associated with the precipitation of stones in the biliary passages.

GALL-STONE FORMATION. Two theories have developed in regard to gall-stone formation. The one, sponsored by Naunyn[39] and his pupils Jankau[40] and Thomas[41] has dominated experimental work for many years. Their work was done on dogs with biliary fistulæ and resulted in the formation of the following theory: The cholesterin content of the bile is constant and independent of the blood and diet cholesterin. The cholesterin of the bile does not result from the general metabolism and is no specific secretion product of the liver. The cholesterin in the bile is derived from the epithelium of the gall-bladder brought about by a "stein-bildende Katarrh," and is initiated by bacterial infection. Naunyn found that in catarrhal bronchitis the cholesterin content of the sputum was 0.9 per thousand and in putrid bronchitis 1.5 per 1000 c.c. He assumed similarities in the pathological processes of catarrhal inflammations of all mucous membranes, attempted to show that an increased formation of cholesterin accompanies all of these inflammatory conditions and found in this conception the chief underlying factor in gall-stone formations. The presence of various organisms in the centers of the stones as well as in the gall-bladder wall lent support to this hypothesis.

Lichtwitz,[42] in a recent critical review of the literature, concludes that at present we have no evidence of any interrelationship between blood and bile cholesterin. Since his time, however, both the work of other investigators and unpublished work of our own have definitely proved this relationship.

This relationship is the main support of the tenets of the opposite group. Aschoff and Bacmeister,[43] were the first to point out that, morphologically, those gall-bladders in which pure cholesterin stones were found show practically no inflammatory reaction. On the basis of this and some experimental work they advocated an "aseptic cholelithiasis" and advanced the theory of the cholesterin diathesis. The experimental basis for their theory is inconclusive, as it is necessary to prove a relationship between the cholesterin content of food, blood and bile.

[39] Klinik der Cholelithiasis, Leipzig, 1892.
[40] Arch. f. exper. Path. u. Pharmakol., xxxix.
[41] Inaug. Diss., Strassburg, 1890.
[42] Ueber die bildung des Harn- und Gallensteine, Berlin, 1914.
[43] Der Cholelithiasis, Jena, 1909.

Von Renvers,[44] from a purely clinical view-point, believed that an aseptic as well as a bacterial cholelithiasis existed. No laboratory evidence was given to support this view.

Discussion. Assuming as our premise that the bile is a composite solution in which the cholesterin is held in a colloidal state, it follows readily that if simple precipitation occur the quantitative analysis of the stones found would reflect comparatively accurately the relative proportions of the solid substances in the bile. This would be true only in the event that no extraneous factor had been added which would tend to disturb the normal equilibrium. The actual state of affairs is demonstrated in the following classification, made from a quantitative chemical stand-point, of the stones examined in our laboratory. It is shown that there are:

1. Practically pure cholesterin stones. These average from 98 per cent. to 75 per cent. of pure cholesterin. We have considered this type as demonstrating the precipitation theory in accordance with the views of Aschoff.

2. Stones containing from 75 per cent. to 40 per cent. of cholesterin (layered stones), which we consider as having been formed in a bile partially saturated with cholesterin to which some extraneous factor has been added. These stones may be formed secondarily from stones originally belonging to the first group.

3. Stones containing from 40 per cent. to 5 per cent. of cholesterin. These stones are the small faceted stones with nuclei containing bile salts and some cholesterin and an outer shell usually consisting of pure cholesterin. These stones are infectious in origin. However, their formation may follow previously existing stones belonging to the first two groups.

4. Bilirubin-calcium stones. These stones are rarely found in the gall-bladder, much more frequently in the intrahepatic ducts and occasionally in the common bile duct. Practically all of the stones found in the cases of intrahepatic cholelithiasis are of this nature. These stones may have an infectious origin or may be formed by an increase in the bile of the precipitated substance. The cholangitis which usually coexists can be considered either as a primary or secondary factor.

Clinical knowledge supplies several of those extraneous factors which tend to disturb the normal proportions of the bile ingredients. These are:

1. Infection. Catarrh in the Naunyn sense would add from the exudate a higher quantity of cholesterin. The amount added, however, would form a relatively small porportion of the total. In other varieties changes in electrochemical potential might conceivably cause a precipitation.

2. Stagnation in the bile passages produced either by inflammatory stricture at any point of the duct system or by impaction of a previously formed stone.

[44] Ther. d. Gegenwart, 1908, No. 3.

In addition the studies detailed above have shown intimate relationships between food, blood and bile, which may be summarized as follows:

(*a*) The cholesterin content of the blood of various animals and human races depend on the cholesterin content of the food.

(*b*) The cholesterin content of the bile is dependent upon the cholesterin content of the blood.

(*c*) A marked increase of the cholesterin content of the blood will cause a marked increase in the cholesterin content of the bile. The converse of this is also true.

It is therefore possible to add another extraneous factor:

3. Hypercholesterinemic conditions in the blood.

The natural history of gall-stone formation goes to show that cholelithiasis is specially common in women who have been pregnant and among the people of the western part of the world who have omnivorous dietary habits. In those races studied by de Langen,[45] whose habits of life as regards food ally them to the herbivorous class, it is known that cholelithiasis is extremely rare. This phenomenon has been commented upon by the early English physicians and was confirmed by de Langen.[46] The latter also points out that when stone formation does occur in these people the calculi are almost always of the bilirubin-calcium variety and rarely of the cholesterin type. The relation between the low blood cholesterin contents and a comparative rarity of gall-stones is most significant.

Among the people of the western part of the world the great frequency of calculous formation in women is associated with the occurrence of pregnancy. During this physiological epoch the cholesterin content of the blood is continuously high and the hypercholesterinemia is protracted for a variable length of time after the birth of the child. It is common clinical knowledge that the first attack of gall-stone colic often takes place during the pregnancy or puerperium or a short time immediately thereafter.

When gall-bladder disease is found to affect men the clinical picture is frequently dominated by the evidences of bacterial infection and the finding of stones in the gall-bladder or bile passages is a secondary factor. Frequently, indeed, no stones are found.

It is not possible to ignore the significant and constant relationships outlined in this communication between the food, the blood and the bile, nor to accept as pure coincidences the association of abnormally high cholesterin contents of these three factors with the occurrence of gall-stones. The fact that in most of the cases the bacterial element, either primarily or secondarily, seems to dominate the clinical picture gives to it an undue prominence. Far better that we recognize the importance of the metabolic element in the pathological picture. Only then will it assume its proper place as one of the criteria upon which rational treatment can be founded.

[45] Loc. cit. [46] Loc. cit.

SOME CLINICAL OBSERVATIONS ON THE LINGUAL TONSIL, CONCERNING GOITRE, GLOSSODYNIA AND FOCAL INFECTION.[1]

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Anatomical observation and description of the lingual tonsil was given by Wharton,[2] Morgani,[3] and Koelliker.[4] Stoehr[5] gave its embryological development and histology in 1891.

The first clinical observation concerning it was recorded by David Craigie[6] under the title of "lingual quinsy," according to Sir Henry Butlin.[7] Since that date a considerable time seems to have elapsed in which no observations on it are recorded. Clinical record of it begins again with McBride,[8] Curtis[9] and Swain[10] (1884–1887), and since then it has made up a considerable literature; but even now this is very little compared with the writings upon the faucial or pharyngeal tonsils. This would argue its neglect or oversight by many observers who have contributed so much upon the other tonsils. This neglect is further emphasized by the very small consideration it has received from text-book writers.

It seems to me the lingual tonsil plays a far greater and more variegated part in the practice of laryngology than is generally thought. It is probably the most frequent clinical issue in the adult throat.

In my experience acute follicular lingual tonsillitis is not an infrequent accompaniment of acute follicular faucial tonsillitis in old or young, but is, however, overlooked unless the examination be made with the laryngeal mirror. In patients who have had the faucial tonsils enucleated it may replace the acute faucial tonsillitis, but is liable to be less frequently recurrent. Lingual quinsy is rare. The evidence of the acute lesion is striking, *e. g.*, dysphagia, fever, redness and swelling of the mass at the base of the tongue, with or without white or yellow spots marking the openings of the follicles. As the acute process subsides a widely variegated picture may follow and endure apparently forever.

[1] Read before the American Laryngological Association.

[2] Died 1763.

[3] Died 1771.

[4] Entwickillungsgeschicke, 1876, 2 Auft.

[5] Festschrift, Naegali u. Koelliker, 1891.

[6] Edinburgh Med. and Surg. Jour., 1834.

[7] Diseases of the Tongue, 1900.

[8] Adenoid Tissue at the Base of the Tongue, Med. and Surg. Soc., Edinburgh, July, 1887.

[9] Influence Exerted on the Singing Voice by Glandular Hypertrophy at the Base of the Tongue, New York Med. Jour., 1884.

[10] Deutsch. Arch. f. klin. Med., 1886, xxxix, 504.

Conspicuous in the symptoms of the subacute or chronic lesion is the sense of mucus in the throat with or without swelling of the mass. There may be mucus actually, but frequently only the sensation which "cannot be cleared away by either up- or down-going efforts." This sensation, moreover, is often wrongly placed by the patient. Many times I have known the most intelligent patients to refer it to the nasopharynx and vigorously maintain they had to "clear something" out of the back of the nose. And I have known such patients treated for many years for "naso-pharyngitis." The reference of the sensation into the larynx is more frequent.

The sensation of pain in chronic cases is less frequent. In the subacute ones it may be present and located correctly or referred to the ear. It may be sharp on swallowing or be a sense of general stiffness, and may exist with much of the local appearance (redness and swelling) absent. Such cases often pass as gouty or rheumatic throats. I have, however, never found a "gouty" throat with the lingual tonsil *normal*, and they have been uniformly relieved by local treatment of the lingual tonsil. I have seen such a pain ful throat translated as caused by the "small embedded" faucial tonsil. It is, of course, disappointing to patient and surgeon when a perfect faucial tonsillectomy fails to relieve these symptoms. The sensation of a foreign body is often described as "a lump over which my throat must jump in order to swallow." Allied to this is the sensation described by patients as "falling of the palate" or "elongation of the uvula." The uvula under these conditions may or may not be a little longer than normal.

The globus hystericus of classical description may exist. Most cases of this phenomenon, however, in my experience have been acute or chronic tonsillitis in easily excitable or "nervous" people. This was also the observation of H. L. Swain in 1886.[11]

Cough is a frequent manifestation of all grades of lingual tonsil-litis. Particularly annoying is that accompanied by a sense of a feather tickling in the throat, which wakes the patient out of sleep, combined often with choking. It may possibly arise from contact of the enlarged tonsil with the epiglottis. It may be excited by laughing. The cough may be of any degree or duration. In the acute cases it may be intensely painful because the expired blast of air pounds upon the inflamed mass from below.

The veins of the lingual tonsil are a frequent point of bleeding in hemorrhage from the throat.

Enlargement of the mass may push the epiglottis down, causing strangling in sleep should the tongue fall back even to the slightest degree.

The singing voice is frequently disturbed by or lost because of

[11] Loc. cit.

lingual tonsillitis. The complaint is frequently that "I am uncertain of my tone," "I sharp or flat," which is what singers often refer to as bad "placing." Attention was called to this fact by Holbrook Curtis, 1884.[12] It is also very distructive to the durability of the voice for singers or speakers. They can sing or speak for a few minutes only when the voice gives way or cracks. This may happen because of the "stiffness of the throat," or because of the vulnerability of this inflamed district. It will not stand the work put upon it by such extra efforts. It is easily irritated and becomes uncomfortable or painful. The faucial tonsils are far less often the cause of or even party to these disturbances (at least in my opinion).

As a possible place of focal infection with systemic manifestations, the lingual tonsil should be quite as carefully and as seriously investigated and considered as the faucial tonsils. I have often seen it reëstablish the systemic condition "rheumatism" for which the faucial tonsils had been enucleated, and I have seen that condition relieved by treatment of the lingual tonsil without the enucleation of the faucial tonsils.

As a factor in thyroid gland disturbances the lingual tonsil had not been recorded prior to my mention of it while discussing Dr. Shurley's paper before this Association in 1912. Seven years ago I saw in one of my own children (aged four years) the right lobe of the thyroid swell (to what appeared to be 50 per cent.) as an accompaniment of an acute follicular lingual tonsillitis. The sore throat was only six hours old, more marked on the right side. She had never had tonsillitis of any sort before nor any disturbance of the thyroid. It behaved like the glands in the neck with faucial tonsillitis. The lingual tonsil and thyroid were apparently normal again in ten days. The association of the thyroid, with the faucial tonsillitis, was called to our attention by Dr. Theisen in 1904 and Dr. Shurley in 1912. With my associate, Dr. C. A. Gundelach, in the St. Louis Children's Hospital, I have frequently seen this combination in children for whom the faucial tonsils had been enucleated long before. The clinical observation of this combination has been verified in adults by my associates, Drs. H. E. Miller, C. H. Bardenheier, W. M. C. Bryan, M. F. Arbuckle and H. B. Miller. I know of no explanation to offer for it. The lymphatics of the lingual tonsil are not known. In early fetal life an association of the thyroid with the base of the tongue exists. This was described by Bochdelag[13] and His[14] as the thyroglossal tract. Sir Henry Butlin[15] thinks this explains the anomalously placed thyroid masses along this tract which are sometimes met with. But he does not think that a thyroglossal duct has been proved in the

[12] Loc. cit. [13] Oesterr, Ztschr. f. prakt. Heilk., 1886, xii, 683 et seq.
[14] Arch. f. Anat. v. Physiol., Anat. Abth., 1891, 26. [15] Loc. cit.

adult. In an unsuccessful effort to prove a lymphatic connection, Dr. Gundelach and I have made a number of experiments, painting the tonsil with India ink for two weeks prior to the removal of goitres of various kinds. The thyroids did not show the ink. It is an inoffensive procedure and patients do not object to it, but we have not had a longer chance than two weeks. Were it prolonged into months it might answer better. We have also injected ink into the thyroid of guinea-pigs and dogs but failed to find it transferred to the lingual tonsil. But this clinical combination, together with the satisfactory results of treatment, make me feel this report to be justifiable.

In cases of thyroid enlargement of moderate grades of almost any duration it has proved helpful to treat the lingual tonsil even though it appeared normal. (As a fact, however, it very seldom has been normal. Often one lobe of the thyroid has been larger with a more marked lesion of the lingual tonsil of that side.) The goitre becomes softer and then smaller. These cases are frequently accompanied by a low or moderate hyperthyroidism. This also is much relieved or cured. The sense of strength and endurance of the patient rises rapidly. Indeed, hyperthyroidism may exist without external enlargement. In these cases the result of treatment is even more satisfactory, and in the few exophthalmic cases that I have had the opportunity of observing some were much helped and one case was cured. The goitre and exophthalmos shrank rapidly. The weakness, nervousness, tremor and frequent pulse were relieved. The case was apparently cured and has remained so for four years. It had lasted one year when treatment of the lingual tonsillitis was begun. It was six months in treatment, consisting of small applications of saturated silver nitrate to the lingual tonsil two or three times a week.

It is self-evident that cystic degeneration of the thyroid will not be helped by treatment of the lingual tonsil. Sometimes, however, one is surprised to see an old, hard, fibrous enlargement soften and diminish somewhat under such treatment. For the worst cases thyroidectomy must serve.

As a factor in painful tongue, lingual tonsillitis has seemed to me to play a causative part. This distressing condition is described by Sir Henry Butlin[16] as glossodynia, and he calls attention to the fact that the papilla at the junction of the palatoglossal fold with the tongue is very frequently inflamed in these cases. It seemed to be a part of the syndrome. No explanation for this can be offered at present. Many times I have seen this papilla involved, with pain in the tip of the tongue as a part of a lingual tonsillitis, and remain so many months after the attack in the tonsil had disappeared. The lymphoid tissue of the tonsil often extends to this

[16] Loc. cit.

point. Recently I saw these papillæ take part in the reaction from a galvanocautery destruction of the mass at the lowermost part of the lymphoid tissue at the base of the tongue 1 cm. to each side of the middle line.

DIAGNOSIS. The diagnosis of lingual tonsillitis is simple in acute follicular cases. Should it not assume the follicular markings it is often overlooked, particularly when the mass is not enlarged. It is recognized under these conditions by its color alone. The mass may be much enlarged in acute or chronic cases, which is, of course easily recognizable. Not so easily interpreted is an occasional small slightly reddened follicle. These are often the origin of the symptoms.

PROGNOSIS. The prognosis for singers and speakers according to my experience should be guarded. A lingual tonsil which easily becomes a disturbing factor either from the work of singing or speaking or from infection must be considered most seriously. I do not believe that the singing or speaking voice can be developed to any great extent under these conditions.

TREATMENT. The treatment of lingual tonsillitis in the acute follicular stage is like that for the faucial tonsils under like conditions. For the subacute or chronic state, with or without enlargement, nothing has been so satisfactory as applications of a small amount of silver nitrate saturated in 50 per cent. glycerin. Salicylic acid saturated in 95 per cent. alcohol is helpful and does not taste so unpleasant. These may be made daily or as seldom as ten days. For the enlargement, galvanocautery destruction has seemed best. Myles's lingual tonsil guillotine also serves well. Hemorrhage following surgery of the lingual tonsil is more difficult to manage than any in the upper air passages. It is fortunately rare.

I am aware that many of these observations have been made and recorded in more or less this form. The association of lingual tonsillitis with thyroid gland disturbance, focal infection and with glossodynia I believe has not hitherto been recorded.

It is my interpretation of clinical laryngology that the lingual tonsil plays a major role. I am aware also that this is in opposition to the views of some of the most distinguished observers, notably Sir Henry Butlin, who expresses himself very clearly on this point.[17] I believe, furthermore, that laryngologists share his views to a greater or lesser extent.

An extensive bibliography of this subject is found in Hymann's *Handbuch d. Laryngologie*, Band ii, S. 638, "Die Krankheiten d. Zungentonsille," von J. Michael.

[17] Loc. cit.

WAR MEDICINE

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SURGICAL TREATMENT OF WAR WOUNDS.[1]

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As the present war has brought out entirely new military problems, so has the preconceived notion of treatment of wounds required entire revision. The wounds inflicted today are by new forms of projectiles, the supply of which in contrast to former methods is absolutely lavish. Deep trench warfare has rendered the soldier a filthy and constantly contaminated person, particularly the trenches of Flanders and Northern France, dug in soil which for centuries has been saturated with manure and other fertile sources of infection.

The treatment of war wounds is a highly specialized branch of surgery, and the rules of civil practice apply hardly, if at all, at the

[1] Read before the Medical Society of the State of New York, May 23, 1918.

front. Moreover, we have to deal with a different kind of individual than in civil practice. In the latter phase the factory hand who is badly hurt will, however, have been in good condition immediately prior to his injury, will have come from clean surroundings, his person and clothing will be relatively uncontaminated, will recently have had food and drink and will not have been exposed unduly, and perhaps for a long time, to the effects of cold and wet. When injured some form of competent relief is almost immediately at hand and transportation to a well-equipped hospital usually speedy and comfortable. Moreover, the treatment at this institution can usually be given promptly. The elements of fear and anxiety and the strain of prolonged expectation of injury are likewise absent.

The wounded soldier will probably have been subjected to harassing conditions of warfare. His injuries may be multiple. It may be some time before he is picked up and in addition to the other conditions he may be deprived of food and drink, especially the latter, for a long period of time. The journey out of the trenches is long, tedious, hazardous and may greatly add to the patient's shock. It is therefore obvious that special training for proper treatment of such cases must be obtained and must be derived from practical experience at the front and cannot be replaced by theory.

The three main factors of wounds are (1) shock, (2) hemorrhage and (3) sepsis. The latter element in this war is almost 100 per cent. possibility. Soon after the outbreak of hostilities it was generally conceded that this constant element of sepsis must be combated by something more than the usual line of treatment for every-day trauma.

In addition to laying open wounds freely, three things quickly developed, namely, the importance of early treatment, no matter what kind, the bad effects of leaving projectiles and other foreign bodies in the wounds, and the necessity of actual destruction of the bacteria. The first has been met by constantly moving up better organized lines of relief closer and closer to the front. At the present time it is aimed, if possible, to do such thorough and early surgery close to the lines that relatively little remains to be done at the rear. It becomes obvious that even by modern antiseptics no foreign body, usually contaminated as they are, could be sterilized by any method, no matter how efficient or thorough.

Credit is due to Dr. Carrel and his co-workers who have demonstrated that although bacteria can be very efficiently combated in the tissues at almost any stage, these methods fail in the presence of foreign bodies. Also proceeding on these lines it becomes evident that tissues which were damaged made favorable places for bacteria and were of themselves a source of danger.

It was pretty clearly demonstrated in 1916 by Carrel and some of those who followed his methods accurately, like Depage at LaPanne, that the Carrel method, providing the patient came under treat-

ment early and was submitted to thorough operation, namely, free excision of the tract of the missile and the removal of all foreign bodies, acted as an efficient prophylaxis against infection.

It will be appreciated that even with the demonstrated efficiency of chemical sterilization, good surgery applied at a very early stage was almost a *sine qua non*, and, in fact, chemical sterilization became an adjuvant and not a substitute for good surgery.

The Carrel method is well known or should be. In order to be efficient it must be done rightly. To be done rightly requires a series of steps requiring infinite care and continued treatment under the same conditions. It is quite impossible, under the unusual circumstances of warfare, to give the great bulk of wounded men who come to hospitals near the lines in large numbers, and in a short space of time, such treatment.

The present-day generally accepted method as practised by the Allies on the Western Front aims at prophylaxis of wound infection by a method which, in some ways, is simple, and if it can be carried out efficiently gives such good results as to minimize the necessity of complicated or prolonged after-treatment. The present-day method aims at the radical excision of all open wounds, removal so far as feasible of all foreign bodies, be they what they may, and the complete removal of all bruised, infiltrated, damaged or "shocked" tissue. Operations done on this principle and done thoroughly by highly competent surgeons, with a large experience in this particular line of work, give the surest guarantee against the development of all forms of sepsis, particularly the dreaded gas gangrene.

It has been my privilege to observe the workings of this method in both the British and French Armies. The principles in both armies are about the same, varying only in minor degrees and particularly in those of organization. This radical excision of wounds is usually done in the British Army in the so-called "Casualty Clearing Station," which will be situated ordinarily from five to ten miles back of the lines.

The wounded soldier is first brought to a dugout back of the trenches where first aid is administered and then to the dressing station, say one to three miles back of the lines at the end of the communication trenches, at a place where ambulances, motor or horse, can come with comparative safety.

The casualty clearing stations are mostly under canvas. Their units can be multiplied readily. In so-called "peace" times they have approximately 200 beds and a medical staff of 6, which can be increased to 800 or more beds and a medical staff of approximately 25. The patient is brought in carefully warmed ambulances, usually under a sufficient amount of anodyne to diminish shock, both physical and psychical. He is carefully unloaded in a waiting room which is well warmed and protected from drafts and passes

into an examining room when his wound and condition are carefully investigated by a highly trained and competent physician who decides on the various steps he will need.

A very few cases of apparently simple conditions may be transferred directly to a base hospital from the casualty clearing station, but the majority of the cases will need some form of operative procedure. The minor cases which form a large group are handled by a special surgeon and a special department and their conditions taken care of either with or without a local anesthetic or with "laughing gas." A certain group of cases may require operation, but their conditions are so precarious that it must be postponed until the patient can be brought back into better condition. These are sent to a special department, called the Resuscitation Ward, where they receive special attention and where there are special resources. Emphasis is placed on heat, particularly heat as given in hot-air baths. The administration of fluid is important as the dehydration of these patients add to the gravity of their conditions. When these patients seem in a condition to stand operation they are returned to the "pre op room," where all the patients await their turn to go into the operating room. Patients requiring an operation which is perhaps not very urgent may wait in the "pre op room" several hours, giving precedence to the more urgent cases. The patient is still kept very warm and is cleaned up to the extent his condition will allow. Badly shocked patients are little disturbed, their clothing being removed on the operating table when they are anesthetized. When the patient comes to the operating theater he is operated on by the surgeon, the head of the surgical team.

A surgical team consists of an operating surgeon of recognized capacity, a physician who acts as anesthetist and at other times does work around the hospital, particularly in the after-care of patients, a nursing sister who acts as assistant surgeon and instrument nurse and a trained orderly. These teams, which generally have been working together for many months, make for the highest efficiency and organization. These teams now bring with them a portable operating table and a supply of routine instruments. This system allows the localization of both personnel and apparatus when it is needed and under most economical management.

The English group their major operating in one single operating theater. This system makes for distinct economy of space and equipment and I have never seen any evidence of confusion arising from this method. (This plan is in contrast to the French system in which each surgeon has his own cramped and very small operating room.) The patients are, for the most part, given a general anesthetic, having already received in transit a generous supply of morphin. The skin is disinfected by mechanical cleansing with soap and water and 5 per cent. alcoholic picric acid solution, which is very efficient and non-irritating.

The surgeon is guided also in some cases by roentgen-ray pictures. In times of greater activity many roentgen-ray examinations have to be omitted and it is only in "peace" times that an appreciable amount of plates can be made, the patient having to be examined under the fluoroscope. The French have developed their fluoroscopy and other means of foreign body localization to perhaps a higher degree than the British and seemed supplied with rather better material resources.

The operation having been conducted along the lines already stated, it is customary in both armies to swab out the wound with some form of antiseptic, the most popular being ether, why, I do not know. Rather small and superficial lesions can be sewed up like ordinary operative wounds, but in the British Army the deeper wounds are more likely to be packed with gauze soaked in paraffin oil containing some form of antiseptic. One per cent. iodoform seems to be the most popular.

These patients are then returned to the wards, most of them to be evacuated on the first hospital train if their condition permits. While it is the aim of the casualty clearing station to evacuate patients for military and psychical reasons as soon as possible, it is generally planned to keep head, chest and abdominal cases one week.

At the base, wounds are redressed and packing removed at a varying time, usually on the average from five to six days. It is stated that the condition of the wound then allows of early suturing in layers and that the results are generally good. I have no means of corroborating this statement from personal experience, but I believe it to be true.

In the French Army primary suture of these wounds is done rather more freely than in similar institutions of the British Army and considerable reliance is placed on cultures; but if the culture shows a streptococcus or Bacillus perfringens the wound is immediately laid wide open and treatment of the open wound is instituted, either by the Carrel method or some other method as the operator practices.

With the French Army this means a somewhat closer relation between the H. O. E. (Evacuation Hospital) and the bases. Moreover, the French, so far as possible, like to have the base hospitals in which the work is to be continued only a relatively short distance away. It is the belief of the best surgical minds in France that a hospital situated at a point farther away than 40 to 60 km. does not really perform the function of an acute hospital but rather that of a convalescent home.

I deem it inexpedient to go further into the treatment of war wounds when they have been transferred in the later stages to the base hospital. The farther away from the front and the longer the time that elapses from the injury, more do the conditions resemble those of civil practice, and it is not my purpose to enter into consideration of these.

I recommend a pamphlet entitled "Surgical Treatment of War Wounds, in the Medical Units of the Third Army, British Expeditionary Force, with Special Reference to Casualty Clearing Stations, February, 1917," which gives thoroughly and more in detail some of the points I have touched on in this article. I append two articles from this pamphlet:

RECEPTION AND DISTRIBUTION OF CASES IN A CASUALTY CLEARING STATION.

BY CAPTAIN E. W. N. WOOLER, R. A. M. C.

RECEPTION OF CASES. On arrival, patients are sent to the reception room or rooms. If only one is available it is partitioned so that lying cases go to one side of the partition, walking cases to the other. It is better, however, to have separate huts for each class. Their names are entered in admission and discharge books. They are then sent to separate dressing rooms, one for lying cases and one for sitting cases. In case of a big rush, accommodations for 100 to 200 cases or more should be available near the reception huts, where patients may be put before their names can be taken. This prevents the ambulance cars being held up unduly.

Dressing Room. The dressing room for lying cases should have accommodation for about 8 cases on folding tables at one time. These wooden tables should be substantial, and are made in such a way that when the stretchers are placed on them the poles of the stretchers fall over the sides of the tables and so facilitate the dressing of patients. They are arranged in two rows of four, each of the two medical officers on duty dealing with the cases in one row.

Annexe. A part of each dressing room is screened off to form an annexe for the performance of minor operations.

DISTRIBUTION FROM DRESSING ROOMS. A. *Lying Cases.* All cases fit to be evacuated to the base forthwith are sent to marquees or huts, where they are fed and otherwise attended to until a train is available.

The following is a rough classification of those cases which are detained:

1. *Abdominal Cases.* Abdominal cases in which penetration of the abdomen is suspected. Wounds of the chest, especially of the lower part, of the lumbar region, sacrum or buttocks should always lead one to examine carefully for abdominal symptoms.

2. *Chest Cases.* Chest cases in which penetration of the chest is evident from the urgent symptoms present. Other cases in which penetration is merely suspected or very doubtful can be evacuated at once.

3. *Head Cases.* A large proportion of head cases, namely, those with "compression" symptoms or which show undoubted evidence

of injury to the brain, especially if brain matter is exuding from the wound.

4. *Gas Gangrene.* Cases of gas-infected or suspected gas-infected wounds, *e. g.*, a limb showing tension even though there is no evidence of actual gas formation.

5. *Femur.* Cases of compound fracture of the femur and all other fractures which cannot be thoroughly cleaned up and efficiently splinted in the dressing room.

6. *Oozing.* Cases of deep-seated hemorrhage, even though the vessel concerned is not a large one. Many men arrive in an exsanguine condition, owing to their wounds having oozed steadily all the way down; but the appearance of the wound at previous dressings has not led each succeeding M. O. to attach much importance to it. By the time the man arrives at the casualty clearing station he has lost quite a considerable amount of blood.

7. *Shock, External Hemorrhage.* All cases suffering from shock, external hemorrhage, etc., unfit for evacuation, whether cases of above types or not, *e. g.*, cases of multiple wounds.

8. *Flesh Wounds.* A variety of flesh wounds which do not admit of immediate evacuation, or which cannot be dealt with in the operating annexe, *e. g.*, a limb showing a large wound (but no fracture), with considerable destruction of muscle tissue. The extent of operation required may be beyond the limits of the annexe with gas anesthesia, and the case should therefore be sent to the theater.

Disposal of Cases. 1. *Abdominal Cases,* if fit for immediate operation, are sent to the preoperation room for preparation. If unfit for operation at the time of admission, they are sent to the ward set apart for resuscitation of cases, or to the special abdominal ward.

2. *Chest Cases.* Chest cases are sent to wards set apart for them.

3. *Head Cases.* Head cases are sent to the preoperation room.

4. *Gas-infected Wounds.* Cases of gas-infected wounds are sent to the preoperation room.

5. *Compound Fracture of the Femur.* These cases as well as some other fractures are sent to the preoperation room.

6. *Hemorrhage.* Cases of deep-seated hemorrhage are sent to the preoperation room.

7. *Flesh Wounds.* Cases of flesh wounds are sent to the preoperation room.

8. *Shock, etc.* Cases suffering from shock or effects of severe hemorrhage are sent to the resuscitation wards.

The M. O. in charge of these wards (preoperation, chest, and resuscitation) notifies the surgeon-in-charge as soon as a case is fit for operation or develops symptoms necessitating immediate operation. Cases suffering from active hemorrhage which cannot be dealt with in the dressing room should be notified to the surgeon-in-charge of the theater at once.

General Principles Guiding the M. O. in Deciding Whether to Evacuate or Detain a Case. 1. If there is any tension, edema or inflammation around the wound.

2. The presence of a thin brownish discharge which exudes under pressure.

3. An odor "fecal" in character.

4. If the wound is one in which gas-infection is likely to develop if left alone, *e. g.*, a small wound of entrance which has become wholly or partially occluded and in which there is much laceration of deeper parts.

If the condition of a wound is satisfactory and presents none of these appearances or if its condition can be dealt with in the operating annexe, such a case may be evacuated. The presence of any one or more of these phenomena, which is outside the scope of the annexe, should lead to the case being detained and sent to the theater.

5. Some cases which have been lying out for several days and are suffering from the effects of exposure and starvation should be detained, although their wounds might admit of their being evacuated.

6. Finally, attention must be paid to the number of cases accumulating for the theater, and should that number become large—say 40 or over—cases may have to be evacuated which would otherwise, for the sake of safety, be sent to the theater. Their wounds should be opened up by well-placed incisions. This can sometimes be done without anesthesia, *e. g.*, in a transverse wound, by incision on the distal side where the nerve supply has been cut off.

Annexe to Dressing Room. This consists of a part of the dressing room, screened off and fitted up for the performance of minor operations under gas or ethyl chloride anesthesia. By having such an annexe the theater, which is always working at high pressure, is relieved of a certain amount of operative work, and the routine work of the dressing room is thus interfered with less than if operations are carried out in it. There is also the additional advantage that other men do not see anesthetics being given nor operations being carried out.

Type of Case and Extent of Operation Suitable for Operating Annexe. 1. Cases of gunshot wound in which a foreign body can either be felt or seen projecting beneath the skin and which can be easily removed. When, *e. g.*, abdomen or joint is implicated, such cases *must* go to the theater.

2. Cases of gunshot wound in which enlargement of the wound will afford better drainage and lessen the risk of the wound becoming occluded and developing a gas infection.

3. "Simple," in the strict sense of the term, as opposed to "compound" fractures, *e. g.*, of the femur, for application of a Thomas splint.

4. All cases of compound fracture which require redressing and reapplication of the same or another type of splint, but which do not call for immediate theater treatment. This only applies to cases in which the wound is freely open and there is no great comminution of bone as all severe compound fractures should be sent to the theater.

5. Lastly, if the pressure on the theater is great, a few cases in which a limb is practically severed may be dealt with and amputation completed, provided other considerations, such as the general condition of the patient, admit of this procedure. As the stumps in most of these cases will require extensive trimming, amputation is not recommended for the annexe except under conditions of extreme pressure.

Following the administration of gas, etc., cases should be detained in the annexe for a quarter of an hour before being sent to the evacuation shelters. This principle is of more importance with reference to cases which have received theater treatment and are suitable for evacuations.

ORDINARY CASES WHICH SHOULD BE "TAKEN DOWN" WITHOUT FAIL IN THE DRESSING ROOM. 1. When dressings are soaked with blood.

2. When splints are not applied properly or when unsuitable splints have been used.

3. When swelling has occurred, particularly in distal parts of limbs, which may indicate "concealed" hemorrhage.

4. When genuine complaints of much pain are made, especially if of recent development, possibly indicating a gas infection.

5. Every case of gunshot wound of the head. Many cases with severe fracture and with brain matter exuding *walk* into the dressing room.

SCHEME OF LABELING. In the distribution of lying cases from the dressing room it is necessary to employ some scheme of labeling in order to avoid confusion. The larger proportion of cases will be found fit for evacuation (probably about three-quarters), and these are marked with a red label bearing the letter "E." Other cases are labeled with a label, the color differing according to whether the case is intended for chest wards, preoperation room or resuscitation wards, etc., each label bearing the name of the ward in addition. By combining the name of ward with a distinctive color, there should be no mistake on the part of the stretcher-bearers as to the allocation of a case. Except in the case of red "E" labels, the numbers of which must be unlimited, the number of other labels for chest and resuscitation wards should correspond to the number of beds available in each ward. The labels are sent back to the dressing rooms as the patients are evacuated and are kept there in a special box for each sort. In this way the M. O. knows when such a ward is full. By checking the number of labels issued for the preoperation room

an indication of the amount of work awaiting the theater staff can be obtained.

Walking Cases. In dealing with "walking cases" the same general principles are followed as with the lying cases and the same scheme of labeling is employed.

A small operating annexe for minor operations is also screened off for the same type of case and with the same scope of operation as in the lying cases.

Cases for Evacuation from the Dressing Rooms are sent, "sitters" to a large shelter, lying cases to special marquees in the Evacuation Department, where they can be fed and otherwise attended to. Marquees are available also where sitting cases can go and lie down if they wish to, pending the time for their evacuation by train. If there is much delay, many of these cases will require dressing.

The Preoperation Room. The preoperation room should be capable of holding at least 30 to 50 cases on stretchers. Every case for operation, except those mentioned above for special wards, passes through this room before going to the theater, and is undressed, shaved, etc. In this way the wards are spared a great deal of unnecessary work, as no case for operation, unless specially collapsed, etc., is taken to any ward until it leaves the theater. In addition the patients benefit by remaining on the stretchers until they are put on the table, and have not to be lifted from stretcher to bed, or *vice versa.*

Some Impressions Gathered in the Dressing Room. *Question of Frequency of Dressing.* A very large number of both lying and walking cases have been brought in which have been dressed at the regimental aid post, advanced dressing station, main dressing station, and, in some cases, finally at the corps dressing station, before reaching the casualty clearing station. On an average these dressings have been done during a period of six to twelve hours. So far as the walking cases are concerned, this appears a waste of time and of dressing material, and in lying cases, especially those severely wounded, is, in addition of very doubtful value from the point of view of the patient.

In order to lighten the work at a casualty clearing station it would be well to develop the work at main dressing stations in a more specialized way, *e. g.*, by having an experienced officer to select cases, serious ones, including all fractures, not requiring immediate attention, to be sent on at once to the casualty clearing station; lighter cases, likely to be able to travel to the base, to be carefully dressed and labeled in some way to indicate that they need not be dressed again at the casualty clearing station, whether labeled in this manner or not. It will be made evident, from the papers which are to be read, what points require special attention from M. O. S. in field ambulances, etc.

In a general way the rule should hold that no dressing should be changed unless there is some definite indication for it.

THE ARRANGEMENT OF WORK WHEN TWO OR MORE CASUALTY CLEARING STATIONS ARE WORKING IN CONJUNCTION. 1. *Each May Be on Duty for Twenty-four Hours at a Time.* This is most practicable in quiet times, but during an offensive one the casualty clearing station alone may not be able to deal with all the cases which may arrive in that period; and, again, it frequently happens that under this scheme one casualty clearing station is worked very hard for one period of twenty-four hours while the other is comparatively quiet in the succeeding twenty-four hours. Lastly, during a period of this length, cases for operation accumulate and many have to wait even until next day before they receive attention. The danger of gas gangrene developing under this system is evident.

2. *Each casualty clearing station* receives a definite number of cases (*e. g.*, 200) and is then relieved by the other. The disadvantages of this scheme are twofold. In the first place the receipt of 200 cases may not be any indication of the amount of work which has to be done. For instance, three-quarters of the 200 may be walking cases, and therefore the amount of operative work involved is light compared with that which may fall to the lot of the other casualty clearing station should their 200 be composed of a large proportion of lying cases. The danger of gas gangrene involved in the accumulation of cases and consequent delay in treatment is almost as great in this scheme as in the first.

3. *Each casualty clearing station* received a definite number of cars alternately (*e. g.*, six cars).

This scheme appears to have none of the disadvantages of the other two. The danger of gas gangrene through delay in treatment is greatly reduced and the work is divided evenly between the two units. A disadvantage may lie in the fact that both casualty clearing stations will be more or less on duty continuously, owing to the small number of cars taken by each, and therefore will never have a rest for long. But it is upon this small number that the efficiency of the scheme depends.

CONCLUSION. Such is the scheme I would recommend for the reception and distribution of cases, based on three months' experience of dealing with large numbers. The whole basis of the scheme depends upon one main factor—that of deciding in the dressing rooms what is to be done with each case as opposed to any other scheme whereby such decision is arrived at in the wards.

SOME PRINCIPLES OF TREATMENT OF GUNSHOT WOUNDS.

BY CAPTAIN C. H. UPCOTT, R. A. M. C.

After two and a half years of war there is still great divergence of opinion on the subject of wound treatment. This is partly due to the

fact that military necessities make it impossible for any one man to have cases under observation from the time when the first surgical treatment is undertaken until complete recovery. Many men have written lauding this or that form of treatment, but their observations refer only to a certain period in the history of a wound, and they are generally concerned with the powers of some particular chemical application to hasten the healing process. This quest of the healing balm continues, and, I think, obscures the one common point where all agree—the need for free enlargement of the wound. It is of this exteriorization of wounds that I wish to speak.

It must be understood that my remarks are confined to the work of a casualty clearing station, I have no other experience. I have been guided by the behavior of wounds during the few days the patients have remained in the casualty clearing station and by occasional reports from the base on the later progress of cases.

Most cases arrive at a casualty clearing station between six and twenty-four hours after the infliction of the wound, and, provided the patient's general condition permits of it, the sooner the wound is attended to the better. This proviso as to the condition of the patient raises one of the most difficult problems with which we have to deal. A patient arrives profoundly shocked by his wounds, the cold, and the superadded trauma of the journey. The usual methods for treating shock are applied: warmth, fluids, rest and the alleviation of pain.

Recently transfusion of whole blood has been widely advocated. While in some cases the immediate revivifying effect of this procedure is striking, in many the benefit appears to be no more than could be attributed to the bulk of fluid injected. In cases suffering from combined shock and hemorrhage it may be that the blood introduced merely goes to fill the venous pool of the relaxed abdominal vessels. Tight bandaging of the limbs or abdomen is always applicable and should be used in conjunction with transfusion. Apart from blood transfusion the subcutaneous or rectal infusion of saline or glucose remains our chief stand-by in the ward treatment of severe shock. The glucose issued in the form of powder appears to be infected with moulds and solutions made from it soon become turbid, even after sterilization. Indolent abscesses sometimes occur at the site of subcutaneous glucose solution, which may perhaps be attributed to this cause. In the early stages of anaërobic infection the intravenous infusion of sodium bicarbonate is of great value. As a stimulant in these cases a hypodermic injection of 10 minims of a 10 per cent. solution of camphor in olive oil should be given and repeated if necessary.

After a few hours there may be a slight improvement in the patient's general condition; then the symptoms of shock merge into those of an overwhelming toxemia suggestive of "acid intoxication." The pallor becomes more marked, the breathing more shallow and

often sighing, the feeble pulse, formerly imperceptible, becomes increasingly rapid, while the temperature remains low. The patient often vomits; his mind is alert, but there is little complaint of pain. These are the early signs of deeply spreading anaërobic infection, so liable to occur in wounds of the buttock or thigh, and unless an operation is performed promptly the patient will die. The difficulty lies in choosing the moment to stand an operation and before he has been weakened by the toxemia. I am accustomed to rely chiefly on the character of the pulse; as soon as it can be felt at the wrist a one- to two-hourly record of its rate should be kept, and if this shows a progressive speeding up you have an urgent indication for operation.

It is well to bear constantly in mind the state of affairs existing in a gunshot wound, and the objects to be attained by operation. A missile passing through a limb dissipates a considerable amount of its energy in the tissues; they are struck a terrific blow and the greater the resistance they offer the more energy will the projectile lose in its flight. When the resistance is enough to arrest, for example, a bullet, it is obvious that all the energy of the missile is spent in the body. It does not follow, however, that the tissue injury caused by a lodging wound is greater than that from a traversing wound; the special gravity of lodging wounds depends on other factors. Given an equal resistance to its passage, the higher the velocity of the projectile, the greater the damage inflicted on the tissues. And this damage is not limited to the track of the missile; it imparts its momentum to everything in its line of flight, so that a radiating area of vibration is set up destructive to cellular life. If the tissues vary in density, the more compact will be driven through the more yielding, with a shattering effect.

This is the first point of importance; the immediate destructive effect of a projectile is not limited to its path.

The second point is that practically every wound is permeated with foreign material bearing aërobic and anaërobic organisms, and some of the latter are capable of thriving in the devitalized tissues among which they are sown.

The object to be attained by operation is a widely open wound, from whose surfaces all foreign matter and dead tissue have been removed.

Types of Wounds. The types of wounds are so manifold that any classification is difficult, but they may be placed in three groups, to provide headings for the discussion of treatment.

1. *Simple Perforating Wounds in Which the Track is of about the Same Diameter as the Skin Aperture.* An example of this group is a bullet traversing at long range the soft tissues of a limb. Entry and exit are small and the damage to muscle is slight.

The majority of these wounds require no operative treatment, or, at most, excision of skin and fascia. Depending probably on the

state of the muscle as regards contraction at the moment of impact, small entry and exit wounds are sometimes accompanied by great destruction of muscle; such cases belong to group 3.

Wounds caused by shrapnel balls have certain peculiar features. Here you have a smooth spherical projectile of low velocity. Having penetrated the skin, its smooth rounded surface enables it easily to find a passage through the muscles, often without causing much surrounding disturbance, but its velocity is so low that it is very frequently held up in meeting tissue of greater resistance. Indeed, it is remarkable how often shrapnel balls are found lodged beneath the skin after having perforated the body or a limb. If the ball and other foreign material are removed, and the entry wound excised, the track does not often cause trouble, although one would think that the wad of clothing carried in ahead of the ball would give rise to serious infection.

2. *Wound in Which the Destruction of Skin and Superficial Tissues is of Greater Extent than the Destruction of Deeper Tissues.* In such wounds as these (gutter wounds, explosive exits, superficial lacerations, avulsions) the wound is more or less exteriorized and all that is required is the excision of all the damaged tissue, in order to attain the ideal of an open wound with a living, uninfected surface.

If this can be assured, the new wound may be closed by primary suture, but unless one can be absolutely certain that the whole of the original wound surface and underlying "shocked" tissues have been removed without infecting the new wound, suture should not be attempted.

3. *Wounds in Which the Skin Aperture is Small in Relation to the Extent of Damage Inflicted on Deeper Structures.* Such wounds may be divided in: (*a*) lodging wounds; (*b*) traversing wounds.

This group includes the majority of wounds; and, apart from injury to important structures, these are the wounds that most urgently call for surgical treatment.

TECHNIC. 1. *Sterilization of the Skin.* Hairy parts should be shaved. If the skin is heavily caked with mud a scrub with soap and water is advisable; in most cases that may be omitted. Cleanse the skin by rubbing with swabs, wet with an antiseptic, such as Dakin's fluid or eusol, for two or three minutes; follow by rubbing with methylated spirit for one minute. During this process the surface of the wound should be covered with an absorbent swab, so that its discharge may not escape and soil the skin. With a pair of forceps, pack the wound with gauze dipped in 5 per cent. alcohol solution of picric acid (or 10 per cent. iodin).

In the case of a wound of group 3 this allows one to ascertain the direction of the track, a search that is often aided by moving the limb in different directions.

Finally, paint the skin with the picric solution and allow to dry while the towels are being placed in position. I have found that skin

treated thus can be rendered sterile. The process may often be carried out during the induction of anesthesia. Hurry and lack of method in cleaning the skin will result in failure to achieve sterility.

2. *Excision of Gutter Wound* (*Group* 2). The raw surface of the wound is dried and repacked with gauze; it is then completely encircled by an elliptical incision, which should not be less than one-fourth inch from the edges of the wound. It is advisable to complete one side of the ellipse first, cutting deeply through skin and fascia together, and then deepening the cut rapidly until it has reached beneath the deepest part of the wound. This incision is then packed with gauze while the other half of the ellipse is made, so cutting out a wedge of tissue enclosing the wound and not opening into it at any part. The use of a finger in the wound sometimes enables one to cut clear of pockets which would otherwise be opened. If this be done the same finger should be kept in the wound until the excision is completed; it is then disinfected or the glove changed. All bleeding is carefully stopped and the wound closed with silkworm-gut sutures, which should just emerge in the depth of the wound as they cross from side to side. Gum-mastic varnish, or better, "aëroplane dope," makes a good dressing, and the limb should be firmly bandaged to prevent effusion. If the original wound is opened into at any part during the operation, primary suture should not be done, but the edges may be lightly drawn together over a salt pack or the wound may be left open and sterilized by the Carrel-Dakin method.

3. *Excision of Traversing Wound with Explosive Exit* (*Group* 2). Pack the wound firmly with gauze. Enter the knife vertically not less than one-quarter inch from the edge of the wound, and keeping the blade parallel with the sides of the wound, cut all the way around it, deepen the incision if needed until the apex of the wound is reached, thus making a cone-shaped excision of the wound. Dressing may be either a small central tube to the track of the missile surrounded by salt pack or by Carrel-Dakin.

4. *Tunnel Wounds* (*Group* 3). Draw a strip of gauze through the tunnel and connect the entrance and exit wounds by an incision, cutting down on to the gauze, discard the soiled knife, and excise the wound as in 2. Narrow tunnel wounds should not have a rubber drainage tube drawn through them. This only blocks discharge, and if near a bloodvessel it is liable to cause ulceration of its walls.

5. *Traversing Shell Wounds* (*Group* 3). Entry and exit should be excised by elliptical incisions. Usually it is unnecessary to excise more than one-quarter inch of skin around the wound. As a general rule the area of skin excised varies inversely with the skill of the surgeon. In doing this the knife should be plunged through the skin parallel to the track of the missile and an attempt made to excise the tissues around the wound to the depth of the knife blade in one piece. The crushed muscle and aponeurosis in the deeper parts of

the wound are seized with tissue forceps and cleanly excised. If sufficient access is not provided by the original wound excision the ends of the ellipse should be prolonged, so that the sides of the wound may be retracted. It is well to remember that prolonged and forcible retraction of muscle is liable to crush its tender fibers and render them a prey to saprophytes in the wound. The need for powerful retraction may be avoided by the use of free incisions. In dealing with the deeper parts of the wound it is to be remembered that the gravest danger arises from infection with gas-producing bacilli, which grow most readily in dead and dying muscle. The following points are important:

1. If a muscle is deprived of its blood supply it will not bleed when cut and will probably die.

2. A dead muscle will neither contract nor bleed when cut.

3. A muscle in the first stages of invasion by anaërobes (possibly when poisoned by toxine) loses its normal resilience and has a peculiar brick red color.

4. In the later stages of invasion the muscle becomes crepitant and exudes a dark reddish-brown foul-smelling fluid.

Taking singly the most important of these signs is absence of bleeding on section. A muscle may fail to contract when cut so that if this sign is present alone the muscle need not be excised.

6. *Lodging Shell Wounds* (*Group* 3). These are to be dealt with on the same lines as 5 (traversing shell wounds), with the addition that every effort should be made to find and remove the shell fragment and any particles of clothing carried in with it. To this end exploration by sight is more valuable than by the sense of touch alone, whether roentgen-ray localization has been done or not. In these cases it is sometimes difficult to find the track of the missile. If the skin and fascial wound be excised and then the limb be removed, so that the muscles and skin assume different relative positions, the track will become visible and its direction may be gently explored with the finger and excised. In cases in which the metal fragment is lodged among pieces of bone in positions where the wound cannot be opened up I have found the Mackenzie-Davidson telephone probe of great service.

Lodging wounds often need a counter incision, either for the purpose of removing the projectile or to provide drainage. The objection to dependent drainage openings if the Carrel-Dakin treatment is to be adopted must, however, be borne in mind.

7. *Multiple Wounds.* These deserve separate mention on account of their frequency and by reason of the special problems they present. The condition of the patient often will not allow one to deal with each wound as thoroughly as could be wished. The first thing to do is to determine the general direction of the projectiles. A search will generally reveal a graze, a gutter or tunnel wound, giving a clue to the course of the others. It then remains to decide which

wounds should be first dealt with. Excluding fractures or penetration of the body cavities, lodging wounds of the buttocks, thighs, calves, shoulders and root or the neck should receive preference. If "time" presses, other wounds may be simply laid open by an assistant, and a salt tablet wrapped in wet gauze laid loosely in each.

HEMOSTASIS. At the conclusion of all these operations great care should be devoted to hemostasis, for pools of blood allowed to accumulate in the corners of the wound favor the progress of sepsis. Seeing that these wounds are accompanied by much crushing of tissue a plentiful supply of thrombokinase will be present, and once the larger vessels are secured, oozing may be stopped by pressure.

LOCAL REST. Local rest to the injured part is to be secured by firm dressings—and in this respect the salt pack is valuable—or by splints. The use of supporting splints should not be confined to fractures and joint injuries. Further, wounded muscles which have a large excursion on movement of neighboring joints, should be immobilized by fixing those joints.

AFTER-TREATMENT. In regard to the care of a wound after operation; although I know that sterility may be procured by the strict application of Carrel's methods, I am equally certain that these methods are not feasible during a heavy rush of work at a casualty clearing station, however satisfactory they may be in "peace" times.

I believe that for the majority of wounds, after correct operative treatment, the salt pack is the best dressing in times of pressure. But it must be carefully and exactly applied; a little extra time devoted to the proper application of the dressing is repaid by the absence of any further need for disturbance of the wound during the short time that the patient remains in the casualty clearing station. Wounds involving the main vessels of a limb, and fracture with much comminution, are not suitable for the typical salt pack.

I am fully conscious of the inadequacy of this paper; the subject involves so much tedious detail that the principle of wide excision has been ruthlessly applied in its preparation; but I have tried to lay stress on what I believe to be the most important part of the treatment of a wound—its early operative cleansing—without infringement on the subjects of those who are now to deal with regional surgery.

CEREBBOSPINAL FEVER.

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There have been 36 cases of cerebrospinal fever sent to the Base Hospital up to the date of writing, and the majority of these cases have conformed to well-recognized types. With a few, on the other hand, the clinical picture or the bacteriological study has been sufficiently unusual or new to deserve publication. The occurrence of primary septicemia in this disease is important in the bearing the fact may have upon the portal of entry of the infection. Some of the recent papers have accentuated this point[1] and cast some doubt upon the idea of infection of the meninges by direct extension.

The following cases are reported, with the consent of the Chief of the Medical Service, Major N. B. Foster.

Case I.—Private G. A. B., of the 27th Engineers, entered the hospital on February 11, 1918, complaining of headaches. His past and family histories were negative. The patient had been enjoying good health until February 7, when he was taken with a sore throat. This was soon followed by violent frontal headache, pains in both legs and indefinite pains in the abdomen. The symptoms became progressively worse, and on February 11 he was admitted to the Base Hospital. On admission the patient was apparently in deep coma. There was marked opisthotonos, with stiff neck, positive Kernig and increased reflexes. His eyes were sunken, pupils dilated and reacted to light. The breathing was very irregular and apparently an atypical Cheyne-Stokes variety (Biot). Examination of the lungs was negative; heart was slightly dilated; sounds at both apex and base were very distant, weak and irregular. The abdomen, lower extremities and joints were negative.

The patient had a peculiar death-like cyanosis and the skin over the whole body was covered with a cold, clammy perspiration. Over the anterior surface of the neck the whole of the chest and abdomen and over the back are found innumerable purplish-blue hemorrhagic areas. They are not elevated above the skin surface and do not disappear on pressure. Pulses could not be felt. Temperature, 104°; respiration, 48. A blood culture was made immediately. Spinal puncture gave clear fluid under very slight pressure; negative globulin, cell count of 127 per cubic millimeter and a negative culture.

In spite of the negative spinal fluid findings the patient was given both intravenous and intraspinous antimeningococcus serum. The

[1] Herrick, W. W.: Arch. Int. Med., 1918, xxi, 541.

patient grew steadily worse and died about nine hours after admittance.

Clinical diagnosis: meningococcus septicemia and cerebrospinal meningitis.

Postmortem examination: scattered over the entire body are many macular hemorrhages, varying in size from just visible to about 5 mm. in diameter. There is marked congestion of the dura, with edema and intense hyperemia of the pia. There is a marked amount of fluid in the basal cistern. The lateral ventricles are filled with blood-stained fluid. The choriod plexus is intensely congested, with no pus collections. The spinal cord is negative except for congestion. Scattered throughout the peritoneum, pleura and pericardium, heart, lungs and liver are found many pin-point hemorrhages similar to those noted on the skin. Smears made from the cord showed many Gram-negative diplococci. No pus cells found. Blood culture reported twenty-four hours later is positive for meningococci.

Anatomical diagnosis: meningococcus septicemia and cerebrospinal meningitis.

Case II.—Private J. G., of the 154th Depot Brigade, entered the hospital February 18, 1918, complaining of marked pain of the abdomen. His family and past history were negative. The patient began having headaches on February 17. This was soon followed by marked pain in the right iliac region, constipation, fever and tympanites.

On admission the patient was apparently suffering marked pain. The face was drawn, head and neck rigid, spine stiff, tongue coated, breath foul. Examination of the heart and lungs was negative. The abdomen was markedly distended and tender and rigid over the appendix. All the reflexes were exaggerated; Kernig and Brudzinski positive. Over the chest and abdomen were found a large number of irregular subcutaneous petechial hemorrhages, purplish blue in color, which did not disappear on pressure. A tentative diagnosis of spotted fever was made and a spinal puncture done immediately. Seventy cubic centimeters of a clear spinal fluid was removed, under marked pressure, containing 32 cells to the cubic millimeter; negative globulin and negative culture. In spite of the negative spinal fluid the patient was given 60 c.c. intraspinous, antimeningococcus serum. A blood culture was made and 60 c.c. of serum was given. About eight hours later the symptoms became more pronounced and the patient was again punctured and 35 c.c. of cloudy spinal fluid removed. This showed a positive globulin, 89 per cent. polymorphonuclear cells and positive cultures. The blood culture also showed meningococci.

February 19. Spinal puncture was done, 60 c.c. of cloudy fluid removed under marked pressure and 30 c.c. of serum given intraspinously and 40 c.c. intravenously. The temperature dropped from 104° to 99° and the patient was much improved.

February 20. Spinal puncture showed fluid under slight pressure and clear; 15 c.c. removed. No serum given intravenously. The patient's meningeal symptoms are markedly improved but abdominal symptoms are still present.

February 24. There are swelling, pain and definite evidence of inflammation in the left elbow and left knee. Conjunctiva of the right eye is inflamed and contained some pus. Temperature, 99°. Smears from the pus failed to show any meningococci.

February 25. The patient showed definite evidence of acute iritis of the right eye with slight cyclitis.

February 26. The right lens is opaque and there is complete loss of sight. There is still marked pain in the abdomen, with a tendency to tympanites. The right epididymis is slightly tender. There is no history or evidence of venereal disease.

February 28. The patient has developed a marked orchitis on the left side. Right knee now inflamed. Left knee shows definite evidence of fluid. Paracentesis of the left knee-joint reveals purulent fluid. Cultures negative. Patient now has pain in right hip.

March 1. There was 40 c.c. of purulent exudate removed from the left knee and 40 c.c. of serum given in the joint, also 40 c.c. given intravenously.

March 3. Fifty-five cubic centimeters of purulent exudate removed from the left knee and 40 c.c. of serum given in the joint, also 40 c.c. of serum given intravenously. Temperature, 98°. General condition improved. Swelling of the left knee has disappeared. The patient has good motion in this joint.

March 6. Thirty cubic centimeters of cloudy fluid removed from the left knee and 20 c.c. of serum given in the joint.

March 9. The knee has apparently cleared. Iritis and cyclitis improved, elbow- and knee-joints normal. The patient complains of occasional pain in the abdomen and pain in the right hip.

March 18. The patient has had a slight temperature up to 99.8° in the afternoon and complains of pain in the right hip. Paracentesis of the hip-joint showed pus. Cultures negative. A blood culture made at this time was negative.

March 25. Patient's condition has gradually improved, temperature normal, pain in right hip is lessening.

March 31. Temperature still normal, hip much improved.

April 3. At the time of this writing the patient's temperature has been normal for several weeks. Knee and hip in good condition, right eye much improved, patient apparently on road to recovery.

Diagnosis: Cerebrospinal meningitis and meningococcic septicemia.

Case III.—A. C. W., private, 313th Infantry, entered the hospital on January 26, 1918, complaining of indefinite pains in back and headache. On January 25, following a boxing match, he was taken with chills, fever and sweats. This was followed by headache, pains

in the back and bleeding from the nose, and the patient was admitted to the Base Hospital on January 26, apparently not very ill. There was no rigidity of the neck, only slight headache; no Kernig; no increase in reflexes. The eyes showed purulent conjunctivitis. The throat was congested; chest examinations negative. Over the whole body there was found a reddish, papular hemorrhagic eruption with marked itching. No skin parasites were found. The patient was quite dull and answered questions slowly. This dulness increased and shortly after admission the patient showed definite symptoms of meningitis. Spinal puncture was done immediately and the fluid was under marked pressure, purulent, and contained many meningococci. Intensive intraspinous and intravenous treatment were given. On February 4 the temperature was normal, headache and stiffness of the neck had disappeared and spinal fluid was clear; cultures were sterile. The patient was apparently convalescing rapidly.

On February 18, following an indiscretion in diet, the patient was taken with nausea, vomiting and headache and pains in the abdomen. Over the body were found a few petechial hemorrhages. A relapse was suspected and a spinal puncture was done immediately. The fluid was under marked pressure, purulent, and contained many meningococci. The patient's condition was very grave for several days, but he responded to treatment slowly, and within a week he was well on the road to recovery. Convalescence was uneventful and the patient was discharged cured.

Diagnosis: Cerebrospinal meningitis, with relapse.

CASE IV.—Lieutenant L. B., D. C., 154th Depot Brigade, entered the hospital January 12, 1918, complaining of general malaise and headache. His past history was negative, except for a marked predisposition to tonsillitis and "grippal" infection. On January 1 the patient had quite a severe attack of tonsillitis, with chills, fever and sweats. The condition grew progressively worse and January 10 he felt quite sick. He had a severe sore throat, slight frontal headache and general malaise. On January 11 he awoke with a violent throbbing frontal headache and marked pains over both eyes. January 12 and 13 the headache and pains above the eyes persisted; he felt chilly, feverish and stiff. He was then sent to the Base Hospital for treatment.

On admission the patient was quite rigid; Kernig and Brudzinski signs positive; neck quite stiff; reflexes markedly exaggerated and complaining of a terrible headache. Physical examination was negative except for peculiar pinkish spots over the chest, back and abdomen. They resembled hemorrhages into the skin. Tentative diagnosis of meningitis was made and a spinal puncture was done immediately. The fluid was under marked pressure and contained innumerable cells with a large percentage of polynuclears. A few meningococci were found in the smear. The patient was given stren-

uous intravenous and intraspinous treatment, and after the fourth day the symptoms subsided, the fluid became clear, the temperature dropped to normal and the patient was apparently convalescent.

January 29, eight days after the last spinal puncture, the patient was taken with a slight headache, stiffness of the neck and had a slight fever. Over the abdomen and chest were found a few pinkish hemorrhagic spots. Diagnosis of a relapse was made and spinal puncture was done immediately, with removal of 45 c.c. of cloudy fluid under marked pressure. The patient was again given intravenous and intraspinous treatment, and after seven days the symptoms subsided; fluid became clear, contained but few cells and was negative to culture. The patient was apparently convalescent. No punctures were done from February 6 until February 12.

February 12. The patient had a rise in temperature to 104°, slow pulse and a petechial, hemorrhagic eruption over the body and a marked headache. Spinal puncture revealed cloudy fluid under marked pressure, containing many meningococci. For the third time the patient was given intraspinous and intravenous treatment; the symptoms slowly subsided and on the fourth day he was apparently on the road to recovery. Due to the extreme number of relapses it was decided to give the patient occasional doses of serum, so punctures were done on February 19, 22 and 25, and serum was given intraspinously.

February 28. Temperature was normal and the patient's condition is excellent except for a slight hypostatic congestion at the base of the left lung.

March 1. The patient had a sudden rise in temperature, headache and a few suspicious spots over the abdomen. Relapse was suspected and a puncture was done immediately. The spinal fluid was under marked pressure and very cloudy. On account of the extreme reaction which the patient exhibited to intravenous serum it was deemed advisable to discontinue the same and give simply three doses of intraspinous serum on consecutive days. The fluid became clear, temperature dropped to normal and the patient's condition became much improved.

March 11. From March 11 to March 16 there were chills, fever and sweats on every third day; leukocytes, 23,800; no malarial parasites found. Repeated blood cultures were sterile. Physical examination was negative except for occasional tender spots, which arose at various places during the paroxysms. These spots showed definite evidence of acute inflammation and were usually seen along the course of bloodvessels. Special examination of ear, eye, nose and throat and heart and lungs failed to reveal the cause of the paroxysms.

March 20. Chills, fever and sweats occur daily, especially in the afternoon. White blood count, 13,400; no malarial parasites found;

blood culture sterile. Nutrition and general condition of the patient is excellent.

March 28. The patient had a chill, fever and sweat, closely followed by marked headache and stiffness of the neck. Over the body were found a few petechial hemorrhages. This was exactly fifteen days after the last spinal puncture. Relapse was suspected and puncture done immediately. The fluid was very cloudy under marked pressure and contained 98 per cent. of polynuclear leukocytes. No organisms found. Temperature, 104°. The patient was given two doses of intraspinous serum and the temperature immediately fell to normal; fluid became clear and symptoms rapidly subsided. The temperature has been normal for one month.

Paroxysms of chills, fevers and sweats have disappeared. Spinal fluid is negative and the patient is apparently on the road to recovery.

It is well to note that at no time has the patient had a positive blood culture, also that each relapse was associated with a definite petechial rash and that the spinal fluid during all the relapses but two showed meningococci on culture, after cultures had been repeatedly negative during the quiescent stage.

Diagnosis: cerebrospinal meningitis, with relapses.

This case is notable for the number of relapses (five) and the fact that these relapses were apparently reinfections. As an attack subsided the organisms diminished from the spinal fluid, later the fluid becoming clear. During convalescent periods organisms could not be discovered in centrifugalized specimens of the fluid nor by culture. Also, it is to be noted that blood cultures taken at the onset of these relapses were in all instances sterile, although every precaution was exercised to protect an organism of delicate growth.

SUMMARY. Two cases of cerebrospinal fever, with initial septicemia, are reported, the meningococci being present in the blood before demonstrable in the cerebrospinal fluid.

Two cases of meningitis with relapse are reported, the relapse taking the character of reinfection.

REVIEWS

MEDICAL WAR MANUAL No. 5. Authorized by the Secretary of War and under the supervision of the Surgeon-General and the Council of National Defense.

LESSONS FROM THE ENEMY: HOW GERMANY CARES FOR HER WAR DISABLED. By JOHN R. MCDILL, M.D., F.A.C.S., Major, Medical Reserve Corps, U. S. Army. Philadelphia and New York: Lea & Febiger, 1918.

IT is safe to say that none of the series of medical war manuals, of which this is No. 5, exceeds the present small volume in general interest. It has the unusual advantage of reflecting conditions in an enemy country as they have been encountered there during the protracted residence and activity of the author. The paucity of contributions relating to enemy activities, however, does not alone supply the interest of this manual, as the author has presented within its compass a complete bird's-eye of the German medicomilitary organization.

The text is divided into twelve chapters and is profusely illustrated. Many of the illustrations consist of diagrams and scale elevations which relate, respectively, to organization and to the mechanical make-up of sanitary trains, railway ambulances and the like. There are also illustrations of equipment, hospital barracks, etc., but perhaps the most important are those referring to reëducation of the disabled, which show, very graphically, individuals and groups undergoing educational training. There are also excellent cuts of the many artificial limbs and protheses now developed to such a high plane of utility.

The book begins with a consideration of the German medicomilitary organization and proceeds through administrative methods and the subject of base hospitals to the medical and surgical aspects of war, including voluntary and Red Cross nursing. The author specifically states that it is not the function of this book to detail purely medical and surgical considerations, although greater emphasis on the outstanding features encountered in his own experience would have been of undoubted interest. The balance of the book is devoted to the question of reëducation of the disabled, to the orthopedic hospitals and to the broader aspects of social and national relief work.

One of the most interesting chapters is that on administrative

methods and another concerns base hospital supplies, under which a table is given of the medicines issued. The brevity of this list is striking. In commenting on the character of the medical work in the German army the author says: "In general the surgery in German war hospitals was not as good as one had a right to expect. . . . the available competent men have not yet been made use of in the most efficient way."

It is rather interesting to note that no military patient is ever forced to submit to an operation, and *a propos* of the broad field of medical relief the author remarks: "It is a national game in psychology that all classes now are playing under the instructions of the medical faculty."

The book is open to a number of minor criticisms, beginning with the language, which is sometimes loosely constructed and often characterized by unnecessarily long sentences. The opening paragraph of the text illustrates this careless and ambiguous structure.

Space will not permit of enumerating the various side lights on conditions in Germany which a perusal affords, but it can be said, in summary, that this small work constitutes an interesting complement to the voluminous medicomilitary and rehabilitation literature compiled hitherto chiefly from the Allied stand-point.

R. P.

MEDICAL SERVICE AT THE FRONT. By LIEUT.-COL. JOHN MCCOMBE, C. A. M. C., and CAPT. A. F. MENZIES, M. C., C. A. M. C. Philadelphia and New York: Lea & Febiger, 1918.

THE authors of this little book state that it was begun at the suggestion of friends who desired to be told "something" about medical service at the front, and their effort reveals not only "something" but many things of interest in this connection. The text is preceded by a short foreword by Surgeon-General J. W. Fotheringham, D.G.M.S., Canada, before the war associate professor of medicine at the University of Toronto.

The book has the merit of great brevity, and described, with the aid of diagrammatic maps, the actual topographical disposition of men and things during advanced medical service. It is entirely free from unnecessary military technicalities and would seem to give, better than do most brochures of the kind, such a bird's-eye view as one might obtain could he hover in midair over the scenes of medical relief at the front.

Although compiled and written from the British stand-point the principles discussed are not detailed sufficiently to be confusing to students of our own methods; and it is to be recalled, furthermore, that many medical officers of our own army have long since seen service in the armies of at least one of our allies.

The language is for the most part clear and carefully chosen, the illustrations are excellent for the purpose intended and the book can be heartily recommended for those who desire information in this field. R. P.

Medical War Manual No. 6.
Laboratory Methods of the United States Army. Compiled by the Division of Infectious Diseases and Laboratories, Office of the Surgeon-General, War Department, Washington, D. C. Pp. 256; 5 illustrations. Philadelphia: Lea & Febiger, 1918.

This little volume is in effect a condensation of standard laboratory methods, together with descriptions of some special method. The section on quantitative analytical methods was prepared by Dr. Donald D. Van Slyke.

Primarily the book is intended to give the experienced officer some standard of comparison. To those less experienced, it is a valuable guide. The technical procedures given are those which, in the opinion of the Surgeon-General, are the best available at the present time. H. D.

Practice of Pediatrics. By Charles Gilmore Kerley, M.D., Professor of Diseases of Children in the New York Polyclinic Medical School and Hospital, etc. Second edition. Pp. 913; 136 illustrations. Philadelphia and London: W. B. Saunders Company, 1918.

The first edition of Dr. Kerley's *Practice of Pediatrics*, published in 1914, was well received by the medical profession. As a comprehensive and well-edited text-book on pediatrics it has won a place among the best text-books on this subject.

Since the first edition appeared the progress in pediatrics has been such that in publishing a new edition it was necessary to make many changes in the text.

The present edition presents twenty-five new articles as follows: stools; the ammoniacal diaper; amyotomia congenita; ptosis and dilatation of the stomach in older children; duodenal ulcer; mechanical agencies as cause of digestive disturbances; intestinal infantilism of Herter; Vincent's angina; septic sore throat (milk-borne); pollinosis, pollen disease, hay fever; hemophilia (bleeder's disease); dyspituitarism; dystrophy adiposogenitalis; orthostatic albuminuria; precocious menstruation and precocious maturity; congenital stridor; stammering; meningismus; psoriasis; acidosis; acetonuria in children; pellagra; beriberi; blood transfusion and intramuscular injection; hypodermoclysis.

In addition to these new articles, sixteen of the chapters of the

original edition have been largely rewritten; while many lesser changes, including the removal of a great deal of old material have been made.

The article on stools is disappointing in that it is very general and sketchy. It is very necessary and highly desirable to present this subject to students and general practitioners in a clear, definite succinct manner.

Roentgen-ray studies of the stomachs of children has led to an increased interest in the study of digestive disturbances of long standing in children and to a broader knowledge of the anatomical conditions underlying and responsible for such derangements. Dr. Kerley's article on "Ptosis and Dilatation of the Stomach in Older Children," which is well illustrated with roentgenograms, shows the advances which have been made in the recent past in the study and treatment of these conditions.

What has just been said applies equally to an excellent article on "Mechanical Agencies in the Intestinal Tract as a Cause of Digestive Disturbances."

The discussions relative to acidosis, acetonuria, pellagra and beriberi present these subjects in accordance with our present-day conception of these conditions, which have recently received so much consideration and investigation on the part of scientific laboratory research and field workers. I. F. S.

PHYSICAL DIAGNOSIS. By W. D. ROSE, M.D., Lecturer on Physical Diagnosis and Associate Professor of Medicine in the Medical Department of the University of Arkansas. St. Louis: C. V. Mosby Company.

THERE may be some question as to the absolute need of such a book as this, inasmuch as it offers but little new to the subject-matter of physical diagnosis or its classification. It is, however, easy of reference and of possible value to students in the matter of definition and description of signs. Its explanation of the signs by the simple statement of facts, however, is apt to be misleading and does not permit a true interpretation of their value.

The subject-matter includes the physical examination of the respiratory organs, roentgenography and fluoroscopy and the diseases of the respiratory organs; the physical examination and diseases of the circulatory organs; general and special examination of the abdomen and its contained viscera; the examination of the head, neck and extremities and the examination of the nervous system. The description of the Bárány tests is especially well written, and a table showing the clinical facts upon which equilibrium tests are based is very complete.

An appendix gives a very full outline for a case history and physical examination. C. N. S.

NEUROSYPHILIS: MODERN SYSTEMATIC DIAGNOSIS AND TREATMENT PRESENTED IN ONE HUNDRED AND THIRTY-SEVEN CASE HISTORIES. By E. E. SOUTHARD, M.D., and H. C. SOLOMON, M.D. Pp. 496. Boston: W. M. Leonard.

THIS is a splendid and perhaps the best exposition of neurosyphilis so far published. While it has been written primarily for the general practitioner, nevertheless even the most accomplished neurologist can gain a great deal of information from its contents The method of its presentation makes it particularly attractive to the student, for here the case method is used. The authors illustrate their points entirely from the citation of selected cases, which are well analyzed and logically arranged. From these case presentations classifications are built up, until finally every phase of the problem has been fully presented and discussed. It is possible by this method to adequately present the pathological data which the authors have had so much opportunity of studying. This of course makes the book so much more valuable.

In the treatment they emphasized the importance of the intensive method and state that this is the only method which gives results. They say further: "Some of the results give rise to greater optimism than has prevailed in asylum circles, especially in general paresis. We are confident that no one can now successfully make a differential diagnosis between the paretic and the diffuse non-paretic forms of neurosyphilis in many phases of either disease even with all laboratory refinements. If this be so it is improper not to give the full benefits of modern treatment to all cases in which the diagnosis remains doubtful between the paretic and the diffuse non-paretic forms of neurosyphilis. We ourselves advocate modern treatment, not only in the diffuse, but also in early paretic forms of neurosyphilis." A very valuable chapter was added on neurosyphilis and the war. They emphasize the very rapid development of syphilitic conditions under the strain and stress of war, this being one of the striking medical facts brought out by this great conflict

T. H. W.

THE PRESCRIPTION, THERAPEUTICALLY, GRAMMATICALLY AND HISTORICALLY CONSIDERED. By OTTA A. WALL, Ph.G., M.D., Professor of Masteria Medica in the St. Louis College of Pharmacy. Fourth and revised edition. Pp. 274. St. Louis: C. V. Mosby Company.

THIS book, for a long time a favorite among students, has been out of print for some years and its reappearance, thoroughly revised, will be a source of delight to students and to physicians desiring

to check up on careless habits of prescription writing. Of special value and interest is the section on the use of the metric system, and easy methods of acquiring the ability to write correct prescriptions of this kind are thoroughly explained.

Following the full discussion of weights and measures the author takes up the language of the prescription and very practically reviews the essentials of Latin grammar. In the matter of abbreviations he pointedly remarks that grammatical correctness or elegance are subordinate considerations. An error in a prescription which merely annoys a Latin scholar is absolutely insignificant when compared with an error which may lead to the dispensing of the wrong medicine.

The latter part of the book contains an exceedingly interesting history of the prescription which would be enjoyed by every practitioner.

The book is well written, with large type and large pages, and with the exception of some unnecessary repetitions of the subject matter is without criticism. C. N. S.

BUILDING HUMAN INTELLIGENCE. By DR. ARNOLD LORAND. Translation by PHILIPP FISCHELIS. Pp. 451. Philadelphia: F. A. Davis Company.

THIS is a very interesting but rambling criticism of the common diseases of mankind, with constructive discussion of the method of building up the normal individual so that he can live and think better. The author for many years was a physician at the Baths Carlsbad, and therefore had wide experience with all sorts of internal conditions. He begins by discussing the influence of various factors on the faculty of thinking. This part is divided into nine chapters. In this he discusses the influence of metabolism, nourishment, climate, heredity, etc., making some very interesting and pertinent observations. In the second part he discusses the influence of sexual impulse and the sexual difference upon the intelligence. This part is very sane and well thought out. He next discusses the harmful influence upon the thinking ability and their treatment according to the newer principles. In this he discusses the causes of insanity and its prevention, the influence of alcohol, syphilis, thyroid gland and other diseases. One very interesting phase of his discussion of treatment is that he prescribes thyroid gland for practically every disease, even for the prevention of old age! He next takes up increase of thinking ability by hygienic and therapeutic means. This part is full of sane suggestions. He then discusses the power of thinking and rational thinking, their development particularly in practising the senses. He calls attention to the lack of use of the

senses in most individuals. He then takes up memory and its systematic development, rational mental work, rational development of intelligence in children and finally hygienic principles for a reform of school curriculum, particularly in high schools. As can be seen from these headings the author discusses many phases of the developmental problems of the human being, sometimes in a rambling, then again in a very intelligent, philosophical manner. The book is well worth reading and the reviewer read every bit of it with the greatest interest. T. G. W.

DREAM PSYCHOLOGY. By MAURICE NICOLL. Pp. 194. Oxford Medical Publications. Henry Frowde and Hodder & Stoughton, Oxford University Press, Warwick Square, E. C., London.

THIS is a very interesting short analysis of dream psychology. As is well known in Freudian literature the so-called Jung school of Zurich is an outgrowth of the Freudian school at Vienna. In recent years Jung and his followers departed from the original principles as laid down by Freud, with the consequence that the latter has formally stated that Jung and his followers were no longer true psychoanalysts. The author takes Jung's view-point and gives his conception of dream psychology. These views are well known and need not be stated in this review. Interesting, however, is the fact that the author in his argument uses the shell-shock cases which he has had the opportunity of examining in England as examples of his psychology. He compares the mental state sometimes found in this condition with that found in childhood, and states that some of them are like infants and some are "even like infants unborn." They are alive but cannot see, hear or speak, a process according to him of "regression." This is interesting and represents one view-point of the psychoanalytic method of treatment even in such cases as shell-shock. T. H. W.

STATE BOARD EXAMINATION QUESTIONS AND ANSWERS OF THE UNITED STATES AND CANADA. Reprinted from the *Medical Record*. Fifth edition. New York: William Wood & Co.

THE present is the fifth edition of this book, and the fact that over 13,800 books of the first edition have been distributed is an evidence that the work is appreciated. It contains the authentic questions and authoritative answers in full that have been asked by the Medical Licensing Boards of twenty-seven States and the Medical Council of Canada during the past year. It of course is

designed to be particularly useful to the recent graduate in familiarizing him with the nature of the examination to which he must submit before obtaining the right to practise medicine. Its use undoubtedly would be enhanced if the compilers had taken the trouble to arrange a suitable index. Notwithstanding this criticism, however, the fulness of the answers makes this edition of exceptional value to anyone desiring to review medical studies. C. N. S.

A Clinical Manual of Mental Diseases. By Francis X. Dercum, M.D. Second edition. Pp. 479. Philadelphia & London: W. B. Saunders Company.

This is the second edition, the first having appeared barely a year ago. There can be no better evidence of the popularity and need of this book. The second edition has not many changes. There have been some additions made in the treatment of dementia precox, and the author has added some of the recent advances in the pathology of paresis and has made some changes in the treatment. The chapter on psychological interpretation has been a little enlarged and rewritten in part, but no great change has been made; but the second edition is distinctly better than the first. As was stated in the first review it is a sane presentation of mental diseases from the clinical view-point. T. H. W.

The Medical Record Visiting List, or Physician's Diary for 1918. New York: William Wood & Co.

This handy little book is so well known that it needs no comment. Besides containing a weekly list it has appended useful tables of dosage and treatment of emergencies and an obstetrical calendar. C. N. S.

American Illustrated Medical Dictionary. Ninth edition, revised and enlarged. Edited by W. A. Newman Dorland, M.D. Pp. 1179; 331 illustrations. Containing over 2000 new terms. Philadelphia and London: W. B. Saunders Company.

The ninth edition of this well-known and justly celebrated book has just appeared. It has been enlarged and brought up to date by the addition of more than 2000 words bearing upon the war and allied conditions. The mechanical work on the book is exceptionally well done, binding, printing, paper, etc., leaving nothing to be desired. C. B. S.

CHEMICAL PATHOLOGY. By H. G. WELLS, PH.D., M.D., Professor of Pathology in the University of Chicago and in Rush Medical School, Chicago; Director of the Otho S. A. Sprague Memorial Institute. Third edition. Pp. 707. Philadelphia: W. B. Saunders Company, 1918.

THIS valuable book is too well known to need any extensive comment. The entire work has been reprinted to embody the progress of the last three years in the chemical problems of disease. Many subjects have been rewritten, particularly gout, specificity of immunological reactions, anaphylaxis, icterus, acidosis, diabetes and uremia. New sections have been added on the Abderhalden reaction, specificity, chemical basis of growth, atrophy, and the pressor bases.

This edition contains much valuable information on the subject of carbohydrate metabolism resulting from work done in Dr. Woodyatt's own laboratory.

In spite of the war—and perhaps even because of the war—investigations in the chemical problems of disease have continued, so that the present work is a welcome record of newer research both at home and abroad. H. D.

VITAL FUNCTION-TESTING METHODS. By WILFRED M. BARTON, M.D., Associate Professor of Medicine, Medical Department, Georgetown University; Attending Physician to Georgetown University Hospital. Second edition. Pp. 318. Boston: Richard G. Badger.

THIS book brings together in one volume the many functional tests bearing upon the diagnosis of diseases of the heart, liver, pancreas, kidneys and ductless glands, so that medical practitioners are in a position to make a more comprehensive diagnosis.

The fact that the work has gone into its second edition indicates readily the favor it has found among those of the medical profession who are interested in vital function testing.

The chapters on the heart and on the liver and kidney function have been enlarged. The latter include a description of the Van Slyke method of urea determination, test-meal investigations of kidney function, Ambard's coefficient and McLean's index of urea excretion, Creatinin and uric acid estimations in blood and a synopsis of Mosenthal and Lewis's scale of renal involvement.

References to the literature are given, and altogether the book should be of great value to the physician, instructor, clinician and pathologist alike. H. D.

PROGRESS
OF
MEDICAL SCIENCE

SURGERY

UNDER THE CHARGE OF

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Ethyl Chloride as a General Anesthetic of Choice in Operations of Short Duration.—HAGLER and BOWEN (*Surg., Gynec. and Obst.*, 1918, xxvi, 352) say that when their American Unit assumed charge of the Graudenz (Germany) Reserve Hospital No. V, in July, 1916, they found that ethyl chloride had been employed frequently, though not extensively, for inducing general anesthesia. This practice they immediately ordered discontinued upon grounds of its extreme danger. They were induced by the assistants and Sisters to reconsider their action and to resume the practice in suitable instances, the number of which was abundant. They find in summarizing their observations that when clearly indicated, and when administered according to the described technic, ethyl chloride is preferable to local anesthesia, because the patient is spared all pain and because there is great conservation of time and energy. In the stress of active military service, simple and time-saving procedures are welcome aids. As compared with ether and chloroform, ethyl chloride has the advantages of being more rapidly effective, of producing a transient anesthesia from which recovery is immediate and of freedom from disagreeable after-effects. It is also simple of administration, and in an emergency may be given by persons altogether unskilled in the technic of anesthesia. When administered carefully and for short periods only it is apparently free from danger. It is not suitable for the reduction of fractures and dislocations on account of failure in producing thorough muscular relaxation. Its usefulness deserves wider recognition among members of the profession, and particularly among those at present engaged in the national service.

War Surgery of the Chest.—LOCKWOOD and NIXON (*British Med. Jour.*, February 2, 1918, p. 145) say that in no other branch of war surgery is the technic of the operation more exacting, although the

manipulations themselves do not require any exceptional dexterity. Chest cases are as urgent as abdominal cases and should be evacuated direct to the casualty clearing station as soon as they can stand the journey. The better the evacuation from the battlefield and from the advanced medical units the severer is the type of case that reaches the casualty clearing station. Thus deaths occur in the casualty clearing station that would otherwise take place farther forward. The percentage of severe chest wounds reaching the casualty clearing station is very much greater when the casualties are principally due to shelling and bombing, especially of the back areas, when the casualty clearing stations are the nearest medical units. Cases of traumatopnea should be closed (preferably by suture) at the advanced dressing station, or even, if possible, at the regimental aid post. Old chest cases should be given morphin early. Active resuscitation must be carried out at the casualty clearing station immediately upon admission. The majority of severe chest wounds require blood transfusion. The value of *x*-ray examination in chest surgery cannot be overestimated. The complete intrathoracic operation is a serious one and should not be lightly undertaken. Local anesthesia, combined with gas and oxygen (if required), should be employed in chest surgery. Speed and absolute asepsis are essential to success. The operation must begin with total excision of the wound and end with hermetical sealing of the thorax. No fluid must be allowed to collect in the pleural cavity after the operation. Resection and drainage should be a late resort, and are rarely necessary, never unless severe constitutional symptoms of infection are present. Non-operated cases should be treated precisely as postoperative cases. Men who have been exposed to asphyxiating gases bear chest wounds badly. At certain seasons bronchopneumonia is a complication greatly to be feared. In no class of surgery is team work so essential to success.

Treatment of Wounds of the Chest.—HUTCHINSON (*British Med. Jour.*, February 16, 1918, p. 196) says that all cases of wounds of the chest should be treated in special wards or special hospitals. Careful charts should be kept which record temperature, pulse and respirations four times a day. Early diagnosis of infection is important. Every case in which there is more than two finger-breadths of dulness should be aspirated. Cases of open pneumothorax should be closed as early as possible. Cases in which there is a large amount of clot in the chest should be opened, blood and clot evacuated and the chest closed. This should be done as early as possible. Cases in which the hemothorax is found to be infected should be opened, washed out and closed, some antiseptic being left in, preferably an emulsion of bipp in liquid paraffin. Postoperative aspirations must be done in all closed cases the first forty-eight hours after operation. No attempt should be made at the base in France to remove a foreign body from the lung.

The Guillotine Amputation.—MURRAY (*British Med. Jour.*, February 23, 1918, p. 230) says that it is unfortunate that so few surgeons working at the front have not had the opportunity of seeing the after-results of the guillotine method. It may be that the fear of gas gangrene is the important factor which has caused this plan to be adopted so generally.

A guillotine amputation invariably necessitates reamputation, but apart from this the great disadvantage is that by the time the patient arrives in England the skin has retracted so much that a large granulating and suppurating stump is exposed. The dressings are often extremely painful and the subsequent loss of bone, even after prolonged extension to draw the skin down, is sometimes very great. If surgeons in France decide that after all it must be a guillotine amputation it is hoped they will so modify it as to leave much more skin and so dispense with many subsequent troubles and save the ultimate length of the patient's limb.

Pulse Rate and Blood-pressure Observations as an Aid in the Treatment of Head Traumas.—SIEBER (*Ann. Surg.*, 1918, lxvii, 51) says that a rapid encroachment upon the intracranial space by any foreign body produces anemia of the brain and medulla and is associated with a physiological response represented by an increase in the general arterial pressure and decrease in pulse rate. The associated intracranial pressure complications are the dangerous factors in fractures of the skull. When the degree of intracranial pressure equals or exceeds the arterial pressure death results. Frequent blood-pressure and pulse-rate observations not only determine the degree of intracranial pressure but may be utilized as indications for or against the advisability of relieving the pressure. Intracranial pressure should be relieved before the advanced stage of medullary compression and edema is produced. The subtemporal decompression is the advisable method for relief of intracranial pressure. By frequent blood-pressure and pulse observations fractures of the skull may be divided into three groups: (1) Those cases which at no time show any evidence of intracranial pressure; (2) cases presenting definite signs of increase of intracranial pressure; (3) cases presenting signs of advanced medullary compression or in which there is evidence of severe laceration or contusion of the brain.

A Study of Ante-operative and Post-operative Blood Counts in Non-infective Surgical Conditions.—MELENEY (*Ann. Surg.*, 1918, lxvii, 129) says that in surgical cases undergoing operation without infection the white cells increase in number, and about six hours after operation have more than doubled. The response is due almost entirely to the outpouring of polymorphonuclear cells. There is a trivial rise in red cells after operation, but in the subsequent ten days this is followed by a progressive anemia, with an average loss of about 500,000 cells per cubic millimeter. The white cell count may be expected to fall rapidly in clean cases and reach normal on the fourth day. In infected or contaminated cases it will fall much more slowly. Infection and contamination have nothing to do with the initial rise, but on the second or third day after operation they will tend to keep the count high. Other things being equal the count will be higher in those cases in which there are severe trauma to the tissues, many sutures and ligatures used, considerable loss of blood and long anesthesia, especially with ether. Normal individuals will produce a higher leukocytosis than abnormal types.

THERAPEUTICS

UNDER THE CHARGE OF

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The Rate of Absorption and Excretion of the Iodides of Strontium, Sodium and Potassium.—KRAHULIK and PILCHER (*Arch. Int. Med.*, 1918, xxi, 176) conclude from their experiments on human subjects that there is practically no difference in the rate of excretion of the iodides of strontium, sodium and potassium. After ingestion of the corresponding doses of iodide the rate of excretion rapidly increases, reaching its maximum at about the sixth hour, and then decreases rapidly, so that during the third day but 10 to 20 mg. are excreted. A somewhat greater quantity of strontium iodide than of sodium is excreted during the twenty-four-, forty-eight- and seventy-two-hour periods. The difference is slight and probably of no clinical significance. There seems to be no definite ratio between the excretion of iodide and the volume of the urine, in some instances a large volume of urine is associated with a greater excretion of iodide, in others the reverse is the case. About an hour after taking iodide two of the subjects complained of soreness of the pharynx, which persisted for several hours. There was no apparent difference from the different iodides in the time of onset, intensity and duration of the symptoms. A third subject noted an acne eruption of the same degree from the strontium and sodium salts. The authors conclude that the prevalent idea that strontium iodide is more slowly absorbed than the potassium and sodium salt is erroneous. In fact the rate of absorption of strontium iodide is at least as rapid as the rate of absorption of the other salts examined, and both the rate and total excretion seem to be slightly greater with strontium iodide, although the difference is so slight that it is of no clinical significance.

The Value of the Atropin Test in the Diagnosis of Typhoid Fever.—MASON (*Arch. Int. Med.*, 1918, xxi, 1) reports the results of 306 atropin tests performed on 63 patients suffering from typhoid or paratyphoid B infections and on 46 non-typhoid patients. The technic employed by Mason was substantially that introduced by Marris. The average mean pulse rate was obtained by counting the pulse for ten consecutive minutes while the patient rested quietly in bed. The atropin (gr. $\frac{1}{30}$ or gr. $\frac{1}{38}$) was injected subcutaneously, and after twenty minutes the pulse rate was again taken and counted every minute until the acceleration had reached and definitely passed its maximum. The difference between the maximum acceleration and the average mean pulse rate is taken as the "release." Marris found that in most normal persons the increase in pulse rate (the release) was from twenty to forty beats per minute, and that a release of ten beats or less per minute was suggestive of enteric infection. Mason carried out 256 tests on 58 cases of typhoid fever (diagnosis confirmed by blood culture or positive

Widal reaction in 56) and 5 cases of paratyphoid B infection. Eleven of these 63 cases failed to give a positive atropin reaction, that is, a release of ten or less. This high percentage may be accounted for by the fact that 6 of the 11 patients received only one test, and that 3 were extremely restless and toxic. On the average the test appeared on the eleventh day of the disease and disappeared on the thirty-first day. In 12 of 35 cases the atropin test appeared before the Widal, and in 4 it was positive before either the Widal or the blood culture. Of 46 non-typhoid patients 3 gave positive reactions. These patients suffered from acute bronchitis, tuberculous meningitis and diabetes mellitus respectively. The average release of all other non-typhoid cases was 23.9 (extremes 11 to 54). The maximum acceleration appeared 33.5 minutes after injection. From his results, Mason concludes that in the diagnosis of enteric infections the atropin test is of great value.

Common Colds as a Possible Source of Contagion for Lobar Pneumonia.—VALENTINE (*Jour. Exp. Med.*, 1918, xxvii, 27) recovered pneumococci from 43 out of 65 cases of common colds. The incidence of type or group was as follows: Group I, 2 cases; Group II, 2 cases; Group III, 4 cases; Group IV, 35 cases. The cases from which Group II was isolated and one of the Group III cases had been in contact with pneumonia, and it was not possible to decide whether they were merely contact carriers or whether the cold was an actual infection by pneumococci due to contact with the pneumonia cases. In two instances, with no known contact with cases of pneumonia, pneumococcus Type I was found to be the predominating organism, which strongly suggests that it was the etiological agent in these colds. If this is so, common colds of this type must be looked upon as a possible source of contagion in the development of lobar pneumonia due to Type I pneumococcus.

Further Observations on the Clinical Actions of Veratrum.—This report (*Jour. Pharmacol.*, 1918, xi, 89) is a continuation of the previous work of COLLINS and HANZLIK on the clinical action of veratrum album, and comprises 36 observations on 27 different patients suffering from nephritis, typhoid, tuberculosis, eclampsia, etc., and various circulatory disturbances and on two normal persons. The preparation employed was the 10 per cent. tincture of veratrum album administered with one or two tumblers of water to allay gastric irritation. During the observations all patients were lying quietly in bed. The pulse rate was taken every fifteen minutes and blood-pressure was estimated (auscultatory method) every fifteen to thirty minutes. The following is a summary of their findings: Single therapeutic doses of from 15 to 20 minims caused a slowing of the pulse and a fall in blood-pressure, and this occurred independently of such symptoms as nausea and vomiting. Large and repeated doses (25 to 75 minims) caused a fall in both systolic and diastolic blood-pressure and a diminution in the pulse rate roughly proportional to the dose. In the 11 cases of circulatory disorders the effect was most marked in hypertonus (6 cases); less marked, inconstant, or no effect at all in heart block (2 cases), paroxysmal tachycardia, myocarditis, with renal vascular disease, aortic insufficiency (1 case

each). There were no demonstrable effects on the electrocardiogram. The two normal individuals responded to the drug in the usual way. There was practically no effect on respiration from either large or small doses. Control experiments (five) with compound tincture of gentian (U. S. P.) administered under the same conditions as tincture of veratrum album to the same and other individuals, showed no noteworthy effect on the circulation. The effects of veratrum are due therefore to the drug *per se*. They conclude that all the desirable circulatory effects produced by tincture of veratrum album may be secured with doses ranging from 45 to 55 minims administered at the rate of about 10 to 15 minims every half to one hour. Large doses repeated at short intervals are apt to give rise to toxic symptoms, such as nausea, vomiting and some depression. These effects are generally absent with small doses given at longer intervals.

Experimental Studies of the Mode of Absorption of Mercury when Applied by Inunction.—SCHAMBERG and his collaborators (*Jour. Am. Med. Assn.*, 1918, lxx, 142) devised an ingenious experiment to settle the vexed question of the mode of absorption of mercury when applied by inunction. A box was divided into two compartments by means of a partition. In one part was placed Rabbit A (which was to receive the inunctions), with its head projecting into the outer air through an aperture in the end of the box. Rabbit B (the control) was placed in the other compartment with its head projecting through the partition into the compartment in which Rabbit A was confined. Rabbit B was thus constantly breathing an atmosphere heavily charged with mercury. From 0.5 to 1 gm. of mercury per kilogram (about fifteen times the amount used therapeutically) in the form of a 50 per cent. mercurial ointment or a 50 per cent. calomel ointment, was rubbed into the denuded skin of the back of Rabbit A. The inunctions were repeated two or three times in all within periods of from five to nine days. In every case Rabbit A died after a brief period and chemical examination showed considerable quantities of mercury in the kidneys and liver. These findings, taken in conjunction with the microscopic study of the organs, warrant the conclusion that the rabbits died of mercurial poisoning. The control rabbits remained in good condition. Those controls which had inhaled a metallic mercury atmosphere showed traces of mercury in kidneys, lungs, etc. (in one case a considerable amount), but there were no histological changes in the organs. When calomel ointment was used no mercury was found in the tissues of the control rabbits. The experiments were repeated five times, with similar results. These experiments demonstrate that the chief avenue of absorption of mercury, when applied by inunction, is the skin and that rabbits may be fatally poisoned with mercury even when no opportunity of absorption through the lungs exists. Metallic mercury in the form of the official mercurial ointment is more volatile and is much more apt to be absorbed through the lungs than calomel ointments of equal strength. The authors recommend the use of calomel ointment for inunctions on the ground that it is more cleanly than and at least as readily absorbed as the extremely dirty blue ointment.

OBSTETRICS

UNDER THE CHARGE OF

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Attempted Abortion in the Absence of Uterine Pregnancy.—STEIN (*Am. Jour. of Obstetrics*) reports several cases in which a patient was supposed to be pregnant and an attempt made to secure abortion. Various means were used: in one a stick of alum was inserted into the uterus, followed by chill, fever, infection, and death; in another, intrauterine injections were given, followed by parametritis. In another case cited an attempt to push a blunt, irrigating tube into the uterus caused rupture in the deeper portion of the vagina. The wound was sufficiently extensive to require suture, after which the patient recovered. Catheters, douches, tubes, and other rod-like bodies have been repeatedly used for this purpose. Injections of bichloride of mercury have been employed, leading to fatal bichloride poisoning. Portions of catheters and tubes have been broken off and retained. It is impossible to secure an accurate account of these cases, but there are reported between 30 and 40. The laws of several continental countries punish attempted, unaccomplished abortion with imprisonment from some months to a year. In other communities the actual performance of abortion is considered the criminal element.

The Kangaroo Walk in the Management of Puerperal Retroversion.—BECK (*Am. Jour. of Obstetrics*) states that up to a year ago from 20 to 25 per cent. of hospital cases returned to the postpartum clinic with retroverted uteri. In the maternity wards the usual measures were taken to prevent this condition. At the end of the second week examination usually revealed no tendency toward retroversion, but one woman out of every four or five who returned to the clinic a month after discharge had a retroverted uterus. From this it was inferred that many cases became retroverted after going home. To obviate this what was called the kangaroo walk was instituted. This consisted of walking on the palms of the hands and on the feet, with the knees held as stifly as possible; all constriction of the abdomen by corset or skirt bands was removed and high shoes could not be worn. Accordingly, these exercises were taken before the patient was dressed for the street. This was begun on the ninth day after delivery, and finally was increased until the patient walked five minutes in the morning and five minutes at night. Examination during the later part of the second week of the puerperal period showed that with the patient in this position the fundus falls forward and out of the pelvis, resting on the abdominal wall a little above the symphysis. The cervix is carried posteriorly and moves slightly with each step. There is a distinct lateral rocking of the pelvis, and, as the result of this, involution is stimulated and the tendency toward retroversion markedly lessened. Of 82 cases less than 10 per cent. had

retroverted uteri. Three of these 8 cases stated that they had carried out the exercises for si ceen days or more after leaving the hospital; 2 continued for six days, and the remaining 3 stopped in less than six days after their discharge. The remainder of the 82 had carried out the treatment faithfully, and with the best possible results. Involution proceeds far better with this treatment than in ordinary cases.

Phenol Excretin in the Urine of the Newborn.—MOORE (*American Journal Diseases of Children*) in a series of 15 infants found that the phenol excretion in proportion to the body weight is less in breast-fed than in artifficially fed infants. There is, in infants and in adults, a relation between the total phenol excretion and the amount of proteid taken into the body as measured by the total nitrogen excreted in the uterine. Recent investigations show that phenol is quantitatively present in the urine of every newborn infant. The average of 19 cases was 11.2 mg. for the first two days of life. As this is a period of starvation the phenol must originate in part through endogenous metabolism.

Postpartum Hemorrhage.—RICE contributes a paper upon this subject based upon his experience at the Manhattan Maternity of New York City. In 13,000 deliveries there was postpartum hemorrhage in 222 cases, 1 in 58. Among these there were 4 deaths, laceration of the cervix caused hemorrhage in 8 cases not associated with placenta previa. In 3 of these it was necessary to apply suture; the others were treated by hot vaginal douches. In 2 cases of rupture of the uterus the extent of the laceration into the broad ligament was not recognized and packing was used instead of suture. In cases where hemorrhage is due to laceration of the cervix, this fact should be ascertained as soon as possible, and sutures promptly inserted. If the tear has invaded the broad ligament, packing will not control it. In 1 case of laceration of the perineum and 1 of laceration involving the veins of the vestibule, there was profuse hemorrhage until sutures were applied. Prolonged labor, deep anesthesia with chloroform, and shock in operation predispose to hemorrhage. Local causes are substances retained within the uterus, as placenta, membranes or clots. Adherent placenta due to chronic endometritis may cause postpartum hemorrhage, and in these cases the placenta is partly adherent, leaving open sinuses in an operation of the uterine wall. A fragment of retained placenta, no matter how small, may cause hemorrhage even late in the puerperal period, and in one case hemorrhage was so severe as to be nearly fatal on the seventh day. Retained membranes are less important than retained placenta, and the chorion is much more apt to give trouble than the amnion or decidua. When the placenta is delivered too soon the membranes become separated and retained. "Hour-glass contraction" of the uterus is usually caused by improper efforts to deliver the placenta, and rarely occurs under good management. Twins, hydramnios and fibroids occasionally cause postpartum hemorrhage. The most severe form of postpartum bleeding occurs in placenta previa. In 57 out of 75 cases postpartum hemorrhage was present. While in many patients the blood comes from the placental site, in the majority of cases the cervix is torn sufficiently to cause bleeding. As the tear is through a portion of the uterus where there

is no contractive tissue, uterine contractions alone are not sufficient to stop bleeding, and packing is necessary. In 57 cases of postpartum hemorrhage due to placenta previa, there were 2 deaths. One of these was a case of central placenta previa with a cervix dilated only sufficiently to admit two fingers. A bag was used to dilate the cervix, one hour and fifteen minutes being employed for this purpose, and a stillborn child was then delivered by version and extraction. The question naturally arises, would not this patient's chance have been better if Cesarean section had been promptly done? The second case had a severe hemorrhage at her home, controlled by vaginal packing. The removal of this pack was followed by repeated hemorrhage and the patient was treated by version and extraction; death followed from hemorrhage and shock. In 9 cases where packing was used to control the hemorrhage from placenta previa, 5 had temperature during the puerperal period. In outdoor service cases are sometimes delivered before the arrival of the doctor or student, and in 1006 such cases there was excessive hemorrhage in 3 only. A case was described in which the patient had a long second stage in labor terminating in spontaneous delivery. The uterus did not well contract and hot douches, ergot and pituitrin were given, but at the end of two hours the patient's condition not being satisfactory, the uterus was packed with gauze. This was unsuccessful and the patient died from shock.

Subcutaneous Symphyseotomy.—BURKHARDT (*Correspondenz-Blatt f. Schweizer Aerzte*) has developed the technic of subcutaneous symphysiotomy, and finds Frank's subcutaneous method easy to apply and requiring no special instruments. Incision is made in the lower part of the symphysis and in the suspensory ligament of the clitoris, which allows the latter and the urethra to sag loosely, leaving an open space between the edge of the symphysis and clitoris region. There is no special danger of injury to the soft parts even in young nulliparæ. The incision of the skin is not longer than the width of the blade of a scalpel, and can be sutured securely. The cutting from below upward is of advantage and greatly lessens the risk of cutting important organs and tissues. The writer found the symphysis from 36 to 51 mm. high and from 18 to 26 mm. thick in 14 female cadavers.

The Treatment of Eclampsia by Vaginal and Abdominal Section.—BRODHEAD (*American Journal of Obstetrics*), believes that veratrum viride is valuable in cases of eclampsia where the heart is not especially weak. Elimination should be vigorously pushed. Delivery as soon as possible he considers imperative provided the mother is spared extensive lacerations. His choice of a method would depend upon the degree of softening and dilatation in the cervix, the size of the pelvis, the parity and environment of the patient, and the surgical skill and experience of the obstetrician. Where the cervix is not softened and easily dilatable, he would use the de Ribes bag. Where eclampsia appears before labor has begun, induction of labor by the bougie or the rectal tube and the bag is indicated. When the patient is in hospital under the care of an expert obstetrician, vaginal hysterotomy from the fifth to eighth months of pregnancy in cases where the cervix is

long and rigid, will give the best results. Abdominal section has frequently been performed. At the Harlem Hospital 34 cases of eclampsia are reported with twelve deaths, a mortality of 35 per cent. In 14 cases treated by vaginal hysterotomy the maternal mortality was 28.5 per cent. The writer endeavored to obtain records by corresponding with those who had performed abdominal Cesarean section for eclampsia and he secured reports of 174 published and unpublished cases. The maternal mortality was 16.1 per cent., and a number of cases died of conditions which could not be properly ascribed to toxemia. The fetal mortality was 18.8 per cent. The conclusions which the writer reaches are that conservative treatment in the majority of cases in eclampsia gives good results, but where labor fails to develop and there is unusual resistance in the birth canal, that delivery by vaginal or abdominal section at the earliest possible moment is indicated.

SPALDING (*Am. Journal of Obstetrics*) has seen good results in private practice in preventing eclampsia by careful hygiene. When this threatens to be unsuccessful, induction of labor has given satisfactory results. In 20 cases treated for eclampsia at his clinic or seen in consultation, 8 were at home amidst poor surroundings and with meagre assistance, with a maternal mortality of 50 per cent. and a fetal mortality of 37.5 per cent.; of 12 patients treated in hospital, the mortality rate was 25 per cent.

Postpartum Eclampsia with Death and Autopsy.—KEILTY and TAYLOR (*Am. Journal of Obstetrics*) report the case of a well-developed young woman who was delivered of twins and afterward had violent eclamptic convulsions dying sixty-five hours after delivery.

Separation of the Pubic Symphysis and Forceps Delivery.—ALLEN (*Am. Journal of Obstetrics*) reports the case of a primipara, aged twenty-four years, who had been delivered by forceps of a living child thirty-six hours before she was seen by the writer. The soft parts were greatly lacerated and there was loss of control of the bladder. There was a separation of the pubic joint of over three inches. This was easily reduced but it was difficult to maintain the bones in good position, so the application of a Lane plate was carried out. The patient did not have good nursing and this operation was a failure, the separation remaining what it had been before, and a small fistulous opening extending to the loose end of the plate. The patient was transferred to hospital where two one-half-inch incisions were made over the iliac crests at the upper anterior iliac spines, and two ordinary wire nails were driven into the iliac crests and left protruding above the skin about one-half inch. Sterile iron wire was wound tightly around the nails from one side to the other across the abdomen, and a tightly fitting plaster cast was put about the pelvic bones. While this was setting, the patient was held up in a sling and afterward put in a trough-shaped bed. In eight weeks her recovery was complete and two years after operation she remains in good health.

A Case of Cerebral Tumor Complicating Pregnancy.—MACFARLANE (*Am. Journal of Obstetrics*) reports the case of a pregnant woman who had been trephined for cerebral tumor. She became imbecile and

had convulsions for several days preceding labor. The birth of the child occurred in one of these convulsions, the child was living and the placenta expelled in twenty minutes. The patient died two days after delivery and no autopsy could be obtained. The obstetric interest of the case lay in the fact that labor was comparatively short and easy in view of the cerebral condition.

Eclampsia without Convulsions.—CHATILLON (*Correspondenz-Blatt f. Schweizer Aerzte*) reports the case of a primipara, aged forty years, who was apparently healthy during pregnancy and had a spontaneous delivery. Almost immediately after the placenta had been expelled the patient had rapid and weak pulse, grew pallid with cold extremities, and within an hour and a half died. There was no unconsciousness and no convulsions, but autopsy showed hemorrhage into the gall-bladder with extensive bleeding in the liver and minute hemorrhages in many other portions of the body. The right ureter was dilated and so was the pelvis of the right kidney; the child was in a condition of pallid asphyxia at birth and could not be revived. These cases are comparatively rare and are described by some as eclampsia without convulsions, and by others as acute fulminant toxemia. They are invariably fatal and no form of treatment at present known has the slightest effect upon them.

The Management of the Third Stage of Labor.—GIBSON (*Surgery, Gynecology and Obstetrics*) criticises the usage, which is common, of holding and massaging the uterus immediately after the delivery of the placenta. He calls attention to a physiological period of uterine inertia which immediately follows the complete emptying of the uterus, and lasts from five to fifteen minutes. He believes that the use of the Credé method before the placenta has completely separated is a very serious blunder and should be strongly discouraged. In studying the third stage of labor he finds that the placenta separates rapidly when massage is not practised, that bleeding is less, and that the fetal surface of the placenta presents much more frequently in these cases than when massage is practised. He draws attention to the fact that during separation the uterine sinuses are closing by thrombosis at the placental site and that massage must disturb essentially this important process. He follows Tarnier's advice that after labor one should watch constantly, but interfere as little as possible.

The Action of Pituitrin on the Human Uterus.—CHARTERIS (*Glasgow Medical Journal*) tested the uterus of pituitary solution to observe the action of the drug on the tissues. On investigating the non-pregnant tissue material obtained after early abortion, and the uterus removed by Cesarean section at full term, there seemed to be no difference between the action of the pituitrin on the pregnant and non-pregnant uterus. Both contracted, and a rapid response followed the use of the substance. Uterine contractions are more numerous; the individual contraction occupies less time and is followed by a more prompt relaxation, but the general tone of the uterus was markedly increased. The action of pituitrin is very prompt. Within a minute a stimulation which lasted from fifteen to thirty minutes was secured.

A second dose renews the original effect or intensifies the action already produced. In comparison with other substances, none were so efficient. Ergot was unreliable, and only the most recent preparations were active. So far as these experiments went, pituitrin was the most efficient and rapid agent for securing uterine contractions.

GYNECOLOGY

UNDER THE CHARGE OF
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Iodide Solutions in Roentgenography.—The use of thorium solutions as opaque media in pyelography has practically superseded the old colloidal silver solutions on account of the greater safety, but one objectionable feature against thorium is the amount of care necessary in making a satisfactory solution. A more common and inexpensive substance whose aqueous solution is neutral would be preferable. For this purpose CAMERON (*Jour. Am. Med. Assn.*, lxx, 754) suggests a 50 per cent. solution of potassium iodide, which is almost completely opaque to the roentgen rays. The solution is perfectly clear and is strongly saline in taste, but not irritating to the tongue. It has a low viscosity, can be readily sterilized by boiling and is miscible with urine and blood without causing any precipitation or coagulation. The important question as to the possibility of these solutions causing toxic effects or local irritation is being thoroughly investigated. Though from the nature of these substances no such effects are anticipated, it cannot be stated now that they are entirely innocuous. However, Cameron has used solutions of high concentration in the kidney pelvis of the lower animals, and has used a 15 per cent. solution in the human bladder, and no undesirable effects of any nature have been encountered. Excellent roentgenograms were obtained in all instances.

Ureteral Stricture.—Ureteral stricture, or narrowing of the ureteral lumen, due to intrinsic inflammatory changes in the ureteral wall is a disease far more common and of vastly greater importance than the literature or our previous experience has led us to believe, states HUNNER (*Bull. Johns Hopkins Hospital*, 1918, xxix, 1), in presenting a paper based upon an experience with over 150 cases of this condition. According to him the majority of ureteral strictures, excluding those of tuberculous origin, should be classified as simple chronic stricture, and they have their origin in an infection carried to the walls of the ureter from some distant focus, such as diseased tonsils, sinuses, teeth or in the gastro-intestinal tract. This conception of stricture postulates that in the majority of cases ureteral infiltration is primary, and that the other urinary tract lesions so often associated with stricture, such as stone in the ureter, hydronephrosis, pyelitis and pyonephrosis, are secondary.

In substantiation of this assumption, Hunner has had a few cases which have persistently showed no material improvement in symptoms until after the removal of infected tonsils or teeth, and another list of patients who have been dismissed as well after dilatation of the strictures or after getting rid of the pyelitis by dilatation of the stricture and lavage, and who have returned with their old symptoms after a fresh tonsillitis attack or after undergoing dental work. Regarding the symptoms that are presented by these cases of ureteral stricture, it may be stated that pain is the most common, and only in rare cases is it absent. To attempt to draw a pain chart of this affection one would need a diagram of the human frame extending from the diaphragm to the ankles. The most deeply shaded portion of this chart would center in the local area of ureteral inflammation, or in other words, in the broad ligament region deep in the pelvis. From this center of inflammatory discomfort in the pelvis the pain may radiate in any direction, upward toward the kidney, laterally into the hips or groin region, posteriorly, simulating a sacro-iliac joint condition or a sciatica, and downward into the thigh and leg either posteriorly or anteriorly. Next in frequency to the local ureteral pain is pain in the kidney region. This is probably at times a referred pain from the inflammatory area in the ureter, but it is usually due to overdistention of the pelvis of the kidney. The urine may be quite negative on repeated careful centrifuging and microscopic search. Chills and fever are common in cases with urinary infection. A patient with infection may go for weeks or months without chills or appreciable fever and, indeed, may be in apparently perfect health, or may suffer only from malaise and general depression. The stricture is located in the broad ligament region or within 6 cm. of the bladder in by far the greater number of cases. The next most frequent location is at the bifurcation of the internal iliac vessels or about 8 to 10 cm. above the bladder which is from 3 to 5 cm. below the pelvic brim. In both of these regions there are groups of lymphatic glands and at operation these are sometimes found enlarged. The inflammatory area itself varies from a slight annular thickening in the ureteral wall to a condition of diffuse cartilage-like thickening which may occupy several centimeters of the ureter and form a mass a centimeter in diameter, while multiple annular strictures are not uncommon. One of the most interesting side-lights on ureteral disease furnished by this study has been the revelation of the probable cause of most ureteral stones. In operating for a ureteral stone and finding it encased in dense infiltration tissue we have heretofore considered the inflammatory area as due to the irritation of the stone. At present, however, there is abundant evidence to indicate that the stone results from urinary salts being deposited on the inflamed surface of the stricture area. The diagnosis of ureteral stricture depends upon the history, urinary examination, palpation of the abdomen, with special reference to the kidney, and ureter regions, palpation of the ureters through the vagina or rectum, cystoscopy, catheterization of the ureters by specially prepared catheters, and roentgenography. Cystoscopy is usually quite negative, but in the occasional case in which the stricture is near the bladder wall there may be redness and edema about the ureteral orifice, suggesting the picture seen with a low ureteral stone. One of the most suggestive

points in cystoscopy is the finding of a urethral stricture when preparing the urethra for the cystoscope. Although stricture of the female urethra is common after a gonorrheal infection, Hunner has learned by experience to give its presence considerable weight in the diagnosis of a suspected ureteral stricture. The crucial test, however, in diagnosing ureteral stricture is made with the wax-bulbed catheter. The chief end sought in the treatment of this condition is the relief of symptoms, and in the infection cases a urine freed from infection. In all cases suitable for dilatation such a thorough opening of the stricture area should be made that there will be no recurrence. There are very few cases in which the symptoms cannot be ameliorated, and fortunately, in the majority of cases, the patients can be relieved to a large extent if not entirely. There are very few cases of pyelitis in which the infection cannot be controlled, but Hunner believes that time will demonstrate that in many cases it will be impossible to get a permanent dilatation of the stricture and complete relief of symptoms until the original focus of infection has been eradicated. When all the methods of vesical approach fail we have to consider operative measures. No form of operation should be undertaken until as complete investigation as possible has been made of both sides. Stricture of the ureter being bilateral in 30 per cent. of the cases, we cannot afford to take anything for granted in dealing with a case in which symptoms may be confined to one side.

Renal Tuberculosis.—BUGBEE (*Surg., Gynec. and Obst.*, 1918, xxvi, 479) states that the present status of renal tuberculosis may be summarized by stating that it may be a primary lesion, and it arises from a filtration of tubercle bacilli from the blood stream into the parenchyma or tubules of the kidney, where changes similar to those found in tuberculous foci in other parts of the body take place. An effort is always made to wall off the process, but the formation of antibodies is so slow and the immunity of the patient, which may have always been absent or which may have been temporarily diminished, is so low that the lesion usually gets beyond control, and usually goes on to wide destruction of the kidney and extension to the other kidney, to other parts of the urinary tract and of the body. From the nature of the lesion, remissions are common and the symptoms of renal tuberculosis are misleading, often slight at the onset, giving no indication of the extent of the lesion. The diagnosis of this condition may be simple or, on the other hand, the most difficult of all urinary lesions, often requiring preliminary treatment to allay acute symptoms and repeated cystoscopic examinations over a long period of time. The treatment cannot be outlined from a study of the symptoms, but it is most important that the remission of symptoms, often for long periods of time, should not be accepted as a cure. The effort on the part of nature to inhibit the progress of the disease and to limit the lesion should be borne in mind, utilized and encouraged in every possible manner in inoperable cases as well as before and after operation. Occasionally the lesion may become arrested and walled-off but even when arrested, a kidney the site of poorly drained cavities is a menace to the system, therefore, nephrectomy for unilateral renal tuberculosis is the proper treatment.

OPHTHALMOLOGY

UNDER THE CHARGE OF

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Insects as Possible Carriers of Poliomyelitis Infection.—C. T. BRUES (*Department of Health, New York City, Reprint Series, No.* 60, *July*, 1917) states that some new facts of interest and importance relating to the possible transmission of poliomyelitis by insects have resulted from his study of the epidemic of poliomyelitis in New York City during the summer of 1916, but these facts are not so definite or complete as had been hoped. They are also to some extent of apparently conflicting nature, and require at least one unproven assumption to combine them into any working hypothesis. They do not completely disprove the idea that the table-fly (Stomoxys calcitrans) is implicated, although the behavior of the epidemic does not favor this view. The author thinks that to discard the insect-borne hypothesis is to cast aside evidence derived from two sets of experiments, and he regards it unwise to do this at the present time of uncertainty. As suggested by Richardson, it is possible with one assumption to form a working hypothesis based upon rats and fleas which seem to fit the epidemiological observations in general features and in many details as well. The assumption that the rat can act as a reservoir for the poliomyelitis virus should be capable of experimental proof, and it would seem that such experiments should be attempted. This by no means precludes the association of some other insect or warm-blooded animal, or both. In fact, there is a continual appearance of circumstantial evidence that suggests a population other than the human one, acting as an undercurrent and influencing the progress of the epidemic. When the many factors so far in doubt are gradually made known, it will be possible to attack the entomological side of the question with better promise of success. Among the unknown factors which cause the greatest confusion in interpreting epidemiological evidence are (1) the length of the period of incubation; (2) the number of mild, abortive or unrecognizable cases and carriers of the virus and their relation to infection and immunity; (3) the duration of infectivity in clinically recognized cases; (4) positive knowledge of the presence of the infective agent in insects, domestic animals or other possible intermediate hosts or reservoirs of the virus.

The "Standardization" of Market Milk.—"Standardized" or "adjusted" milk is attracting much attention at the present time. VAN SLYKE (*Circular No.* 56, *New York Agricultural Experiment Station*) defines standardized milk as follows: "Standardized milk or adjusted

milk is milk in which the original fat content has been changed, and also the ratio of fat to the other milk solids by the removal of milk-fat or by the addition of skim milk or by the addition of cream." All who have devoted any thought to the subject of adjusted or standardized milk are agreed (1) that promiscuous, uncontrolled standardization should not be considered under any circumstances; (2) that if such treatment of milk is permitted it should be controlled by law as completely as practicable; (3) that this must be done in order to prevent the obviously objectionable conditions which would result from lack of such control. Among the more important conditions that would be necessary to make standardization safe, Van Slyke recommends that no one should be permitted to prepare standardized milk for market purposes without a special State license; that such conditions of standardizing processes should be prescribed as would ensure no impairment of the sanitary quality of the milk. He further recommends that standardized milk should not be permitted to be sold unless it conforms with the legal minimum requirements in composition; that all containers of such milk should be marked with the words "Standardized" or "Adjusted." He also believes that it is all-important to place on every container of standardized or adjusted milk in plain figures the minimum percentage of fat in milk, which shall stand as a guarantee that the milk in the container contains no less than the specified amount of milk-fat. This would serve as a check to prevent adjusting the fat of market milk down close to the present legal minimum standard of 3 per cent. (in New York). It would enable every consumer of such milk to know the minimum percentage of fat in each lot of milk purchased. It would protect distributors and producers against unfair competition, it would have the tendency of helping to adjust or standardize the price of market milk in accordance with the composition of the milk furnished, and, more important still, the successful employment of such a method would probably have the ultimate effect of making the sale of milk on a guaranteed fat basis supersede entirely the present minimum legal standard method for all kinds of milk, whether normal or adjusted.

Total Symblepharon.—MORAX (*Ann. d'Oculist.*, cliv, 321) observes that whereas partial symblepharon can generally be managed readily, such is not the case in total symblepharon with complete abolition of a conjunctival sac. The formation of a new cavity for prothesis is a most difficult problem. The tendency to retraction and contraction of the orbital tissues is such that the most extensive and perfect graft suffers retraction such that the new cavity decreases greatly and may even disappear almost entirely. To obviate this tendency the author has devised a procedure which consists essentially in the formation of two wide "trap-doors," the raw surfaces of which are turned outward above and below by suturing their edges to the skin after freshening the latter. Wide epidermal grafts from the arm, thigh or abdominal wall are then applied to the raw surfaces. At the end of about three weeks the "trap-doors" are replaced and sutured together at their free margins after freshening. A shell of lead or enamel is placed and allowed to remain between the doors and the bottom of the cavity now covered with the graft. At the expiration of from six weeks to three months

the palpebral margins are cut and prothesis is possible. Several illustrations show the conditions before and after operation and three diagrams assist in making the descriptions clear. The same procedure is applicable where the orbital cavity is still occupied by a globe or stump.

Melanoblastomas of the Eye.—FOREMAN and HUGGER (*Am. Jour. Ophthal.*, February, 1918, 97) present a study of these tumors of the choroid. They may be either primary or secondary; the former are the more frequent, and the large majority of these are composed of pigment-producing cells. The pigment-bearing choroidal tumors are usually referred to as melanosarcomas. In this region pigment-free tumors are sometimes observed which differ in nowise either in structure or clinical course from those which contain pigment. Such tumors have been termed leukosarcoma, an unfortunate term because it has been used to designate cases of definite tumor-like mass composed of lymphoid cells, which seem to escape into the blood stream, giving rise to leukemic alterations in the blood. The writers adopt the comprehensive term of melanoblastoma as a suitable group name for all tumors composed either of melanoblasts or chromatophores; it has the advantage of not placing any emphasis upon benign or malignant forms, thus compelling a more careful study and evacuation of individual cases. Marshall in his collection of 134 cases of melanosarcoma of the eye (*Royal London Ophth. Hosp. Rep.*, v, xv, 51) found that the ages ranged from fifteen to ninety years, with an average of fifty years. One eye is affected, as a rule. The cases on record appear to be equally divided between the right and the left eye. Injury is considered an important etiological factor by some authors. In Marshall's series there was a definite history of injury in about 10 per cent. Among the 55 eye specimens in the Museum of Pathology at the Ohio State University, upon which this study is based, there are 4 cases of melanoblastomas arising in the eye. These cases are quite fully detailed from the clinical and pathological stand-point. Case 2 is a study of the liver in an instance of melanosarcoma—the eye had been removed on account of a tumor which the reporters did not have the opportunity of studying, though it seems certain that this tumor was the primary growth, the liver and also the lungs being favorite seats of metastases.

Utility of the Tonometer of Schiotz in Practice.—MARBAIX (*Ann. d'Oculist.*, January, 1918, 27) believes that this intrument gives greater precision than the finger, showing degrees of hypertension which would escape the latter; it has drawn attention specially to moderate degrees of hypertension, 30 to 40 mm., which have been found to occur during the course of quite a number of affections, such as iritis, scleritis, myopia, descemititis, retinal hemorrhages, the appreciation of which may lead to modification in treatment. The instrument is quite applicable, especially in glaucoma, in which the subject remains for a long time under observation and may readily be made to comprehend the importance of repeated examinations. In fact, in the case of any ocular infection in which digital exploration raises a suspicion of a modification in the tension the tonometer should be a real and valuable adjunct in practice.

OTOLOGY

UNDER THE CHARGE OF

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The Morbid Anatomy of War Injuries of the Ear.—J. S. and J. FRASER (*Journal of Laryngology, Rhinology, and Otology*). From this paper the authors exclude those cases of hysterical deafness or deaf-mutism and malingered deafness which have been treated *in extenso* by Moure, of Bordeaux, Lermoyes and other writers, and include direct injuries due to bullets or pieces of shrapnel or high-explosive shell; indirect injury due to blow or falls on the head, these being subdivided into those with and those without fracture of the labyrinth capsule; noise deafness due to prolonged or intense gunfire, and shell or explosion deafness the consequence of a concussion of the labyrinth. In the cases of direct injuries, fractures of the mastoid process or of the external bony canal were observed, some with and some without splintering of the bone; in some of these cases the tympanum and the labyrinth were also involved and the middle and external ear were in other cases injured by bullets entering through the facial bones and emerging through the mastoid or remaining embedded in the temporal bone, the nature of the injury being determined by radiograms, both lateral and anteroposterior, many of the cases of direct injury being complicated subsequently by middle-ear suppuration occurring as the result of infection carried in by the foreign body at the time of the injury or consequent upon secondary infection through the tympanopharyngeal tube or external canal. Indirect injuries of the ear due to fractures at the base of the skull, similar to those reported by one of the authors as occurring in civil life, were also observed, in one case a bullet wound of the frontoparietal region being accompanied by laceration of the brain and hemorrhage into the subarachnoid space. Noise deafness is due to physiological overstimulation of the auditory apparatus, and the author's conclusions are in consonance with the experiments of Siegman and others that the air-conduction of the sound is of paramount importance in the causation of this physiological condition, conduction of the sound waves through the tissue of the body being relatively unimportant. The hair cells of the organ of Corti are first affected, later the supporting cells, and finally the ganglion cells and nerve fibers, constituting a degenerative neuritis, the part of the organ of Corti affected depending, as has been shown by experiments on animals by other observers, on the pitch of the sound. If the noise be of high pitch the neuro-epithelium at the base of the cochlea is involved; if the noise be of medium pitch the organ of Corti in the middle coil is affected, while if the noise is of low pitch, degeneration is found in the portion of the organ of Corti nearer the apex of the cochlea. It is difficult or impossible to draw the line between cases of

noise deafness and those of shell or explosion deafness, as both are due to the excessive movement of the atmosphere conveyed to the labyrinth, the explosion of a shell not only causing a great mass movement of air but producing a loud noise. It is stated, however, that the blow produced by the condensation of air following the explosion reaches the ear before the noise of vibration, and that it may drive the stapes inward and fix it in the oval window so as to lessen the bad effect of the loud noise which follows. Shell or explosion deafness, concussion of the labyrinth, is, according to Lermoyes, the true war deafness, and various theories have been advanced as to the pathology of this condition. In many cases a rupture of the tympanic membrane accompanied by hemorrhage is observable, and it is believed that in these cases of localized injury there is less likelihood of damage to the delicate structure of the membranous labyrinth than in cases in which the tympanic membrane does not give way; mere rupture of the drum-head, however, unless accompanied by some lesion in the labyrinth, auditory nerve or brain, would produce only a moderate diminution of hearing, while patients suffering from severe shell deafness exhibit marked or total loss of hearing, and in these cases some further lesion in the auditory apparatus must be sought. It has been stated that hemorrhages occur in the peri- or endolymphatic spaces of the inner ear, and that the delicate neuro-epithelial sacs and tubes of the membranous labyrinth are ruptured by the violent concussion caused by the explosion, and that in this way a gross mechanical effect is produced in the inner ear. It would appear, however, that the structures of the membranous labyrinth are well protected from concussion because they are suspended in a lymph bath inside the hollow spaces of the bony labyrinth. Hemorrhage may also occur in the internal auditory meatus with or without rupture of the nerve fibers which pass from the fundus of the meatus through the rigid bony canals to the cochlea, utricle, saccule and cristæ of the canals. It has been suggested that, apart from these gross mechanical changes, the explosion and the loud noise may destroy the delicate nerve-endings in the cochlea and so result in paralysis. The loud sound due to the explosion may paralyze the hair cells of the organ of Corti, somewhat in the same way as the nerve structures of the macula in the retina are paralyzed by the rays of the sun in eclipse blindness. According to this theory shell deafness, like noise deafness, is due to paresis or paralysis following overstimulation. Microscopic examination in one case of labyrinth concussion followed by total deafness exhibited a condition of degenerative neuritis similar to that described by Manasse and Wittmaack in old people. It has also been stated that in cases of shell deafness the lesions are probably to be found in the brain—hemorrhages in the pons, medulla and cerebellum, involving the central connections of the auditory and vestibular nerves, shell deafness having, according to this view, a similar pathology to cases of concussion of the brain in which there is no fracture of the skull, namely, multiple small hemorrhages. Investigations of the authors, including 4 cases of shell or explosion deafness. In each case the temporal bone on the injured side having been removed within four or five hours of death, properly protected and prepared for microscopic examination. The first case was one of shrapnel injury of the left ear followed by middle-ear suppuration, and when admitted to the Royal

Infirmary, Edinburgh, about a month after the injury, symptoms of cerebellar abscess were present. Operation revealed mastoiditis and small metallic particles in the mastoid antrum, and in spite of the evacuation of the cerebellar abscess the patient died. The autopsy showed early meningitis and sinus thrombosis in addition to the cerebellar abscess. Microscopic examination of the ear demonstrated a thickened, infiltrated and perforated drum-head with fracture of the malleus, the lower part of the handle being separated from the drum-head and drawn inward by the tensor tympani muscle. The mucosa of the middle ear was distinctly swollen and the tympanic cavity, antrum and cells full of pus. The joint between the head of the malleus and the body of the incus was dislocated. The incostapedial joint was healthy, but there was fracture of the footplate of the stapes and early invasion of the vestibule through the annular ligament. The cochlea showed hemorrhage in the scala tympani of the basal and middle coil and in the opening of the perilymphatic aqueduct, but the nerve apparatus of the cochlea appeared almost healthy. The neuro-epithelium of the saccule and utricle and of the christæ of the canals was desquamating. The internal meatus showed meningitis. The second case was one of indirect injury to the ear, due to a bullet wound, the patient having been hit in the frontoparietal region and the bullet going out just above the ear on the same side. There was no apparent injury of the ear itself, but the parietal bone was shattered and the brain lacerated. The third case was that of a soldier who was taking cover in a house when a high-explosive shell hit the house and burst into the room in which he was, the patient being wounded in many places. On admission to the casualty clearing station the patient was found to be semiconscious, with subnormal temperature, small, rapid pulse, cold, clammy skin and multiple small wounds, showing the usual signs of high-explosive shell injury, including marked deafness. He died twenty-four hours later from shock, there being found on examination rupture of the tympanic membrane, slight hemorrhage in the middle ear spaces and in the fundus of the internal auditory meatus, the structures of the membranous labyrinth remaining normal. The fourth case was an injury to the ear due to the bursting of a rifle grenade. The grenade burst close to the left side of the soldier and caused extensive general injury. These rifle grenades, though much smaller than shells, contain a very powerful form of high explosive. The changes in this case were fairly definite and include a recent rupture of the tympanic membrane, the edges of which were partially glued together by fibrin and hemorrhages in the tympanic cavity, in the marrow spaces in the roof of this cavity and around the geniculate ganglion, and in the fossa subarcuata. There was also bleeding in the scala tympani of the cochlea, in the region of the round window, and a marked hemorrhage in the fundus of the internal meatus. The otolith membrane of the saccule was separated and the neuro-epithelium was irregular, with the cupola of the superior canal also separated. Although the outline of the organ of Corti was preserved the hair cells and some of the supporting cells could not be made out, changes probably due to a degenerative neuritis of the nerve structures. In this case the stress of the explosion had been exerted on the posterior inferior part of the drum-head, the region of the round window, and the fundus of the internal auditory meatus.

Case V was one of shell explosion, the patient suffering from severe concussion and the right side of the head and body presenting multiple wounds. There was a plug of wax in the right external auditory canal, and after its removal the right drum-head was found to be lusterless, opaque and retracted. The internal changes in this case were found to be comparatively slight, due possibly to the protective effect of the presence of the rumen plug in the external canal. There were small hemorrhages in the tubal part of the tympanic cavity, in the canal of the tensor tympani, in the cranial ends of the fossa subarcuata and perilymphatic aqueduct and in the fundus of the internal meatus. The neuro-epithelium of the labyrinth showed little change, but the detachment of the otolith membrane of the utricle and of the cupulæ of the lateral and superior canals is worth recording. In Case VI the soldier had caught the full blast of a high-explosive shell, which burst close to his left side and shattered this side from head to foot, the force of the explosion, however, having been expended in rupturing the drumhead, the structure of the inner ear together with the nerves in the internal meatus having correspondingly escaped. The only changes of importance found in the 4 cases of explosion injury of the ear were: rupture of the drum-head and hemorrhage into the middle-ear spaces, with hemorrhage in the fundus of the internal meatus in 3 of the 4 cases.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

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Investigation of Strains of Tubercle Bacilli from Animal Tuberculosis.—GRIFFITHS (*Journal of Pathology and Bacteriology*) reports the results of experimental work carried on from 1911 to 1916, in which he examined a number of strains of the tubercle bacilli from naturally acquired tuberculosis in animals. Out of 14 strains derived from 10 monkeys, 50 per cent. yielded tubercle bacilli of bovine type, this proportion being much higher than that reported by other observers who found in 37 naturally tuberculous monkeys only 3 (8.1 per cent.) were infected with bovine tubercle bacilli. That so many naturally tuberculous monkeys should have yielded the bovine type is not surprising when it is remembered that monkeys are as susceptible to bovine as to human tubercle bacilli, and when in captivity are frequently fed on cows' milk. But an interesting fact in the majority of "bovine" cases here reported is that the infection appeared to be of respiratory origin, the intestines and mesenteric glands showing only minor lesions, if any. The other animals examined were one cat, one goat and seven birds. The cat, a domestic pet, was found to be infected with a typically bovine type, infection being by way of the alimentary tract. The goat, purchased

for experimental purposes, reacted to the tuberculin test and so was killed and examined. A culture obtained from a lung nodule exhibited the characteristics of the bovine type of tubercle bacillus. This is apparently the only case of natural tuberculosis in the goat in which the type of bacillus has been determined. The seven birds examined comprised a lap-wing, a pigeon, a goshawk, an ibis, a quail, a grackle and a pheasant. All the strains exhibited the characteristic cultural features of the avian type of tubercle bacillus. Griffith included in his report the results of an investigation of the cultural characteristics of a series of strains of bovine tubercle bacilli derived from cows' milk. Twenty-eight strains were examined by him and the findings compared with those of the Royal Commission on Tuberculosis. All possessed the same characteristics, *i. e.*, they varied as to their mode of growth on glycerin media, some being very dysgonic, others relatively eugonic and others displayed intermediate degrees of luxuriance. Another interesting finding incorporated in this report is that of a newly calved heifer, two and one-third years old, vaccinated when four days old with living human tubercle bacilli. Upon examination of the first milk produced a virulent strain of the human type was demonstrated. At autopsy, with the exception of a single minute gray tubercle in the lungs, no sign of tuberculosis was found anywhere in the body. The purpose of this investigation was not so much to show the efficacy of vaccination as to draw immediate attention to the possible danger of using for human consumption the milk of cows which had been vaccinated with living human tubercle bacilli.

The Pathology of Gas Gangrene of Muscle.—Emrys-Roberts and Cowell (*Journal of Pathology and Bacteriology*) recognize three types of gas gangrene clinically: (1) the common type which occurs in the wounded lying out twelve to twenty-four hours or which develops a few hours after the first operation; (2) the fulminating type, in which the patient, if untreated, may be dead in a few hours; (3) the delayed type, with a slow onset so that the condition becomes established several days or even weeks after the date of injury. They emphasize that the formation of gas in the common type is a late phenomenon, that changes in the skin overlying the infected wound precede it; the pallor of the tense skin is followed by a reddish blush, soon becoming a dusky violet, which spreads rapidly from the edge of the wound. Before this the constitutional signs of toxemia are present. The fulminating type of gas infection is favored in gross gunshot injuries of bones, with extensive laceration of muscles, and when the main blood supply to a limb has been completely lost the infection is favored by the presence of the symptom-complex of shock, hemorrhage and exhaustion. From observations on the power of Bacillus aërogenes capsulatus to produce gas in anaërobic media and from their experiments the authors are persuaded that acid is one of the manifestations of its growth in muscle and that acid hematin is responsible for the initial color changes. Gas gangrene is especially liable to occur in deep penetrating wounds and in extensive surface wounds with great laceration of muscle and containing infective material. There is no actual pus on the wound surface, although a sanious, foul-smelling fluid escapes and a thick, turbid

lymph may be seen in the fascial sheaths. At first the surface is hard to the touch, but as the infection spreads, softening occurs and crepitation may be determined. Histologically the superficial necrotic muscle is composed of swollen fragmented fibers with separated perifibrillar sheaths embedded in a fibrous reticulum, in whose meshes are a large number of polymorphonuclear leukocytes, bacteria, red blood cells and débris. Some small blood clots lie in this area and examination showed them to be crowded with Bacillus aërogenes capsulatus, so that it is important to remove these so far as possible. Thrombosis of the vessels quickly occurs and their musculature undergoes lytic changes. In the area of dead muscle the color runs through reds to grays and greens and black. The tissue is no longer contractile. Gas forms late and pushes along the planes of fascia and pressure from this, in the case of such muscle as the tibialis posticus, with rigid fascial compartment, may be sufficient to partially occlude the main vessels. The gas may later burst into the muscle and find its way into the subcutaneous tissue. The authors found that massive thrombosis, apart from that resulting from trauma, is not concomitant of the process of gas gangrene. Histologically, in this area, myolysis was very general and the authors believe that this is due to the toxin of the organism. A fibrinous reticulum with its enmeshed leukocytes is less noticeable in the direction of spreading edge, its place being taken by fluid. The line of demarcation between living and dead muscle fibers is not sharp. Contractility of muscles returns in this area. In the area in which the muscle is contractile some of it may contain extensive blood extravasations. As regards the mode of spread of gangrene it occurs within the fascial sheath; thus the infection is confined to the affected muscle unless the main blood supply is interfered with or unless the exudate, tracking along the sheaths of arteries, nerves and tendons extends the process from one segment to another. In corroboration of this, authors record the case of a man whose penetrating shell wound of the thigh was opened twelve hours after being hit, and who, on the next morning, had constitutional signs of infection and a tympanitic thigh, the wound having the typical odor. The infection was found limited to the sartorious alone. Resection of the whole of this muscle was followed by recovery. In the line of demarcation a white line of fibrin and leukocytes abuts against the contractile muscle. Sloughing sometimes occurs at this line. The authors agree with Emery that toxins produced by the growth of these anaërobes and not the gas are the chief factors in the production of gangrene.

A Method for Producing a Rapid Immunity to Pneumococci.—Much attention has been given to the development of an active immunity to the pneumococcus. Attempts have been made to develop large quantities of antibody in animals for use as diagnostic and therapeutic sera. Various methods that have been used were developed by the individual investigators according to their conception of the important factors entering into the question of stimulating immune substances by pneumococci. ALEXANDER (*Jour. Med. Res.*, 1918, xxxvii, 471) undertook the investigation on the assumption that the immunity in pneumonia was related not alone to the presence of the pneumococcus but also to a reaction of the leukocytes. Pneumococci and leukocytes

were mixed together and incubated for a certain length of time. The mixtures were then used as antigens and injected into rabbits, whose sera were tested for the presence of protective substances. The pneumococcus type II was used in the experiments. The organism was sensitized with immune serum, agglutinated and mixed in definite numbers with leukocytes. After incubation of the mixture it was inoculated intravenously into rabbits. Three daily injections were made and the blood was then tested six to eight days after the last injection. The rabbit serum was tested for protective substances in the white mouse. In this way a potent antipneumococcus serum was rapidly obtained in rabbits. Although ordinarily the rabbit is very susceptible to pneumococcus infection it was found that the sensitized pneumococcus mixed with leukocytes permitted the employment of large doses. The author did not study the manner of effect of the leukocytes upon the pneumococci. He particularly draws attention to the speed with which the protective substances appear in the serum of the treated animal.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

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A Study of the Physical Condition of One Thousand Delinquents Seen in Court.—ANDERSON and LEONARD (*Boston Med. and Surg. Jour.*, June 13, 1918), state that the original purpose of their study was to determine what part, if any, routine physical examination might play in the disposition of a delinquent's case in court, and later in the institution of reconstructive measures while on probation. For this purpose the records of the last 1000 cases were taken from the files and the last physical condition of each person noted; also the relationship, if any, which the physical condition bore to his economic efficiency. Six hundred sixty-eight individuals, or 66.8 per cent. of the cases, were in good or fair health; 342 individuals, or 34.2 per cent.—1 out of every 3 persons—were in poor or bad health, and in such physical condition as to warrant urgent medical treatment. About 626, or 62.6 per cent., were considered self-supporting, while 374, or 37.4 per cent., were not self-supporting. Some correlation between these figures is evident. Thirty-five per cent. of those found to be in good or fair physical condition had been steadily employed, while only 2 per cent. of those found to be in poor or bad physical condition had been steadily employed. Eighty-five per cent. of those found to be in good or fair

physical condition had been and still were self-supporting, while only 18 per cent. of those found to be in poor or bad physical condition had been and were still self-supporting. The chances for being self-supporting were more than four to one in favor of the individual in good physical condition. Additional facts are included bearing upon the frequency of venereal disease among a group of 600 consecutive cases studied. Forty-seven per cent. of these individuals were suffering from one or both of these diseases; an additional 4.5 per cent. had doubtful bloods and smears. Of these 600 cases, 303 were so-called offenders against chastity; of these, 57.4 per cent. were suffering from syphilis or gonorrhea, or both, while an additional 4.9 per cent. were doubtful cases. There were 112 cases of larceny. Of these individuals, 33.9 per cent., or 1 out of every 3 cases, had syphilis or gonorrhea, or both. There were 17 individuals arrested for possession of drugs; 53 per cent. of these had venereal disease. Other types of offenders in court showed a correspondingly high frequency of these conditions. In short, the conclusion reached from this study is that venereal diseases is not limited to any one type of offender in court, but it is found common among all classes of delinquents, and that a policy calling for a more routine investigation of the physical condition and the possibilities of each offender prior to his disposition would seem justifiable.

The Growth-promoting Properties of Foods Derived from Corn and Wheat.—VOEGTLIN and MYERS (*Public Health Reports*, May 31, 1918, No. 22, xxxiii) state that the "highly milled" products are, without exception, inferior in dietary value, as regards growth, to foods prepared from the whole grain. It is rather surprising that such delicate organs as the gastro-intestinal tract of young mice can tolerate a diet containing a large amount of bran. This fact, however, does not necessarily mean that it is advantageous to include the bran in foods intended for human nutrition. On the contrary, the experiences with "war bread" would rather indicate that persons with delicate digestion are subject to temporary digestive disturbances as a result of a change from "white" bread to bread containing a considerable percentage of bran ("war bread"). On the other hand, from the stand-point of dietary completeness, a bread containing all of the grain, with the exception of the superficial cellulose layer, is undoubtedly superior to the so-called white bread made from "highly milled" flour, and would not possess the above-mentioned features. The "white" bread used in these experiments was not adequate for maintaining normal growth in spite of the fact that it was prepared with some evaporated milk and yeast. The most significant defect of "white" flour is the deficiency in antineuritic and fat-soluble vitamin; it is also deficient in adequate protein and inorganic salts. A wheat flour containing a considerable part of the germ and superficial layers of the grain supports growth of mice and pigeons specially well when supplemented with inorganic salts. The same is true of "whole wheat" bread. "Highly milled" corn-grits, forming the exclusive food of young hogs, leads to failure of growth in these animals, whereas the whole corn-kernel, supplemented by inorganic salts, promotes growth. Newborn squabs are suitable animals for growth experiments. No evidence of a toxic action of a whole-wheat diet was obtained in the experiments on squabs which were fed on whole wheat meal,

supplemented by a suitable salt mixture. In the light of our present knowledge it would appear that bread made from "whole-wheat" flour, or old-fashioned cornmeal, should be used in preference to "white" bread and "highly milled" corn foods whenever the diet is restricted to these cereal foods to the more or less complete exclusion of other foods possessing greater dietary values.

The Influence of Cold Shock in the Sterilization of Canned Foods.—BUSHNELL (*Jour. Ind. and Eng. Chemistry*, June, 1918, No. 6, x) states that blanching is of no value in reducing the time necessary to properly process canned foods. Small amounts of salt are of little value in preventing the growth of bacteria in canned foods. Small amounts of organic acid (acetic acid) have a distinctly retarding action upon the growth of bacteria in canned vegetables. The use of small amounts should be advocated in all cases in which it will not injure the texture, flavor or appearance of the product. In many cases an unsterile product will keep indefinitely if properly sealed. This, however, is not true in all cases, and sealing should not be expected to take place of proper processing because of the danger of loss due to spore-forming anaërobes.

A Comparison of the Relative Healthfulness of Certain Cities in the United States Based upon the Study of Their Vital Statistics.—HARMON (*Quarterly Publication of American Statistical Association*, June, 1916) states that the use of a life table furnishes the best single means of comparing communities in regard to their health. The use of standardized death-rates constitutes the next best method, and it is much to be preferred to the use of the crude death-rates. The infant mortality rate is not a satisfactory index of the health of the community, because in most instances there is no accurate method of expressing it. The death-rates from the various infectious diseases do not give comparable results. The death-rate from a single disease apparently does not give a just and fair representation of the healthfulness of a city. In judging the healthfulness of a city, such rates should therefore he used with care and discretion.

Elementary Concepts of Tuberculosis.—KRAUSE (*Am. Rev. of Tuberculosis*, April, 1918, No. 2, ii), states that from three to five years to twelve to fifteen is the golden age of the human span so far as tuberculosis is concerned. At this period the disease is milder than at any other time of life. It is astonishing how many of the apparently desperately sick children will recover from tuberculosis. As in infancy, generalized miliary or meningeal tuberculosis will carry off most of those who die. But if these complications do not develop the immediate outlook is uniformly good. However, cured children furnish many of the chronic pulmonary cases of adult life. Even though cured, such children should be looked upon as cripples. Therefore, whenever possible their future life should be planned with this conception firmly in mind. They must concentrate their talents if they are to be useful members of society and free from tuberculosis. The treatment of tuberculosis does not stop with the arrest of symptoms. A well person's life may have to be watched perhaps for years in order to ward off relapse and prevent an ultimate death from phthisis.

Wound Inspection among Lathe Workers.—SHIE (*Jour. Am. Med. Assn.*, lxix, 1927–1930) states that in a large manufacturing plant the vast majority of cases of wound infections and furunculosis were found to be localized among lathe workers in the machine shops. The peculiar features of lathe work are the use of cutting mixture and oil, and the manner in which these circulate and are used repeatedly, thus making them extremely liable to contamination. The contamination rendered them open to suspicion as factors in the causation of the wound infection and furunculosis. These suspicions were borne out by bacteriological investigation and animal inoculation, which showed the causative factor to be pyogenic organisms which were present in vast numbers in the cutting mixture and less numerous in the oil. Marked results were obtained. Abundant portals of entry for these organisms were found on the arms of workingmen in innumerable small cuts and punctures made by flying chips of steel from the lathes. The methods of prophylaxis possible are by heat, by chemical disinfection and by a combination of the two. Various chemical disinfectants were tried, and the cresol group was found to be the most effective and the least expensive. By use of chemical disinfection (cresols) wound infections have been reduced from 5 per cent. to less than 0.5 per cent. in the plant under consideration, and furunculosis has almost disappeared.

An Anatomical Study of Senescence in Dogs, with Special Reference to the Relation of Cellular Changes of Age to Tumors.—GOODPASTURE (*Jour. Med. Research*, May, 1918, pp. 127–186) states that senescence in dogs is accompanied by multiple degenerative changes in many organs and tissues, and associated with these changes are multiple benign and malignant tumors, which seem to result directly from these degenerative changes. With age there is a progressive differentiation which eventually injures the cells of the body. Many of these cells die, others become de-differentiated in varying degrees. These de-differentiated cells possess the power to grow, but their capacity to function may be diminished or lost. From these de-differentiated cells, metaplasia and benign and malignant tumors arise.

Persistence of Immunity following Toxin-antitoxin Injections.—PARK (*Proc. Soc. for Exp. Biol. and Med.*, April 8, 1918), during the past years, has immunized a series of guinea-pigs and a series of horses and a series of children, with diphtheria toxin-antitoxin mixtures. The duration of the immunity presents certain points of great interest. He states that, so far as his observations go, guinea-pigs are never naturally immune; horses in the very great majority of cases are immune; adults and infants under six months are immune to 80 per cent., while very young children are non-immune to about 60 per cent. In the guinea-pig, active immunity lasts for about nine months; in horses there is increased immunity, due to the injections, which last from nine to twelve months, at which time the horses return to their original amounts of natural antitoxic immunity. In testing human beings from month to month it was a matter of great interest to find whether the infants and children who become immune, due to the injections, would, like the guinea-pigs, lose their immunity in about

nine months or whether the active immunity would be replaced by natural immunity just as in the majority of infants the stage of lack of immunity is followed by antitoxic immunity. He found that in infants two years after successful immunization the great majority have remained immune, not over 6 per cent. losing their immunity. Park states that we have a right therefore to hope that the stimulated immunity has been replaced in the very great majority by a natural immunity, and that this will hold for life. The facts that the protection lasts and that the injections are harmless make the active immunization of infants appear to be a practical measure of eliminating diphtheria.

The Spirochetal Flora of the Normal Male Genitalia.—NOGUCHI (*Jour. Exp. Med.*, June 1, 1918, No. 6, xxvii), states that the varieties of spirochetes enumerated and photomicrographed from the male smegma flora represent practically every form hitherto described by Nankivell and Sundell and by Patterson in the specimens of urine from trench fever cases. The urethral flora as studied by Stoddard seem to contain more varieties, but except those of his more detailed morphological descriptions, every form observed by him is among those found in the smegma. Stoddard saw certain forms with hooked ends suggestive of the Leptospira icterohemorrhagiæ of infectious jaundice, but the resemblance ends with this one feature, and differentiation should always be possible under the dark-field microscope, by means of which spirals the leptospira reveals its highly characteristic minute elementary presenting the appearance of a chain of dots. Of all the spirochetes none has so closely set spirals as the jaundice leptospira, the distance between two spirals being only 0.5 micron. Various methods, including Fontana's, Benians', the mordant gentian violet stain or Burri's India-ink method, are inadequate to differentiate the leptospira from other spirochetes. Why a positive spirochete finding with the films from the urethra and in the specimens of urine was not obtained is difficult to explain, except on the grounds of the paucity of specimens examined. At all events the recent negative results reported by Fiessinger with French soldiers and invalids after cleansing of the urethra and glans seem to be in harmony with Noguchi's results. In conclusion it may be stated that Spironema refringens, Treponema calligyrum and Treponema minutum represent practically all the spirochetal forms observed in the male smegma flora. A leptospira has never been conclusively shown to be present in the specimens of normal urine or smegma. For the satisfactory microscopic demonstration of a leptospira a dark-field illuminator is indispensable.

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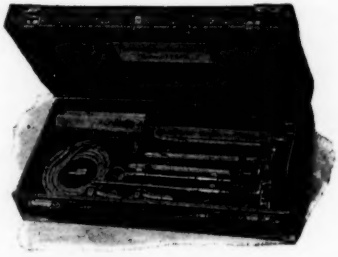

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